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Impact of Changes in Tariffs on Developing Countries' Government Revenue

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IMPACT OF CHANGES IN TARIFFS ON DEVELOPING COUNTRIES' GOVERNMENT REVENUE

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ABSTRACT

This paper addresses tariff revenue concerns that some countries have been expressing in the context of the current multilateral trade negotiations under the Doha Development Agenda. This paper: discusses methodological issues associated with estimating revenue impacts; provides impact estimates for a sample of developing countries; links the differences in impacts to cross-country differences in existing tariff regimes as well as properties of formulas for tariff cuts; and, discusses efficient tax replacement policies and past experiences. Additionally, the paper presents results of a simulation of the welfare effects of reducing tariffs and simultaneously replacing lost tariff revenues with revenues from consumption tax. It concludes with some policy implications.

Key words: multilateral trade negotiations, tariffs, tariff reduction formulas, government revenue, CGE simulation

JEL Classification: C68, E61, E62, F13, F14, H20

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TABLE OF CONTENTS

Tables

Figures

Boxes

Techincal Annex Figures

Statistical Annex Tables

Statistical Annex Figures

IMPACT OF CHANGES IN TARIFFS ON DEVELOPING COUNTRIES' GOVERNMENT REVENUE

Executive summary

This paper examines (1) the impact on developing countries' government revenue, trade flows and welfare following changes in their bound tariffs; and (2) reviews the theoretical literature and past experiences with tax replacement policies.

Tariff revenue concerns have emerged as an important issue in the framework of multilateral trade negotiations under the Doha Development Agenda (DDA). The July framework agreement explicitly identified the tariff revenue issue as a challenge for countries dependent on revenues from import tariffs and instructed the Negotiating Group on Non-agricultural Market Access (NAMA) to take into account the particular needs that may arise for the Members concerned. This paper attempts to aid this process by: discussing the methodological issues associated with estimating revenue impacts; providing impact estimates for a sample of developing countries; linking the differences in impacts to cross-country differences in existing tariff regimes as well as properties of formulas for tariff cuts; and, discussing efficient tax replacement policies.

It is worth noting at the outset that the main objective of trade liberalisation is to enhance allocative efficiency (and hence welfare), and not to preserve government revenue. This paper does not argue for a revenue-neutral tariff reform; far from it. Reducing tariffs brings welfare gains, net of any losses in tariff revenues and these gains are the ultimate motivation for tariff reform. However, even though, in principle, almost any kind of taxation is distortionary, governments raise revenues with the objectives of providing various public services, including ensuring macroeconomic stability, promoting outcomes such as poverty reduction and income redistribution. The rationale for tariff reform is thus important but so is the integration of the recommendations for tariff reform with other objectives of economic policy. Potential revenue shortfalls can undermine macroeconomic stabilisation and development programs and may cause a reversal of the trade reform itself. Tariff reforms should thus be accompanied by well-conceived policies designed to generate revenue in a less distortionary manner.

The paper discusses different methodological approaches that can be used to evaluate welfare and revenue impacts of tariff reduction and, focusing on the Swiss tariff reduction formula, applies them to a sample of 24 developing countries. Based on the simulation results, the paper offers a discussion of cross-country differences and provides sensitivity analysis by changing the Swiss formula coefficient. For the sake of comparison, the results obtained using a linear tariff reduction formula are also presented and discussed.

The paper also offers a discussion of tax reform policies that could accompany tariff reform including a discussion of past experiences with trade-related fiscal adjustment. This approach could serve to lessen potential revenue losses from tariff reduction. Finally, the paper provides a simulation of the welfare effects of reducing tariffs and simultaneously replacing lost tariff revenues with revenues from consumption tax.

The main results can be summarised as follows:

- The literature makes a strong economic case for a non-discriminatory tariff reform that, where necessary, should be accompanied by a reform of the tax system. Developing countries that currently tend to maintain higher and more dispersed tariff barriers are particularly well

positioned to benefit from a tariff reform but they are also more vulnerable to the associated incipient tariff revenue loss. The fiscal implications of tariff liberalisation in developing countries could be addressed either by an appropriate design of tariff reduction modalities and/or by providing assistance in the implementation of a tariff-policy-cum-tax-reform package.

- The fact that in several developing countries many tariffs have not been bound or have been bound at rates that are significantly higher than applied duties highlights the need to seek ambitious tariff liberalisation commitments in the context of the Doha round of negotiations in order to secure meaningful welfare gains for participants. At the same time, large binding overhangs imply that unused protection can be significantly reduced contributing to greater certainty about the future levels of tariff protection without implying any losses to government tariff revenue. In fact, binding of unbound lines and reduction of existing binding overhangs may positively affect trade flows and revenue collection by providing an upper ceiling on applied rates and thereby constraining the uncertainty with respect to future protection levels.

- Many developing countries' applied tariff schedules are characterised by high dispersion of tariff rates in low import demand elasticity sectors and prevalence of high tariff rates in high import demand elasticity sectors. Such a structure of applied rates may in fact lessen any negative revenue impacts of tariff reduction as compared to a situation where high rates are applied on low elasticity products.

- Given that the initial levels of tariffs and the structure of trade of any one country are our starting point (in other words the initial conditions), the results following reductions in tariffs are totally driven by the adopted approach (or modality) for tariff reduction. That is, the extent of changes in tariff revenues are determined by the formula used to reduce tariffs.

- Simulation results of tariff reduction using the Swiss formula indicate considerable cross-country differences in trade, welfare and revenue impacts. This is due to differences in the initial levels of tariffs and differences between bound and applied rates (binding overhangs). In particular, countries with higher initial tariffs and lower binding overhang experience deeper percentage revenue loss but also larger trade creation and welfare gains. Cross-country variation in revenue impacts does not seem to be driven by differences in these countries' aggregate responsiveness to trade prices changes (for a given set of trade elasticities).

- The link between the initial level of tariffs and the depth of proportional revenue reduction where high tariff countries experience deeper percentage reductions in tariff revenue (and at the same time larger trade creation and welfare gains) can be associated with the properties of the Swiss formula itself (and the assumed trade elasticities) and does not extend to the case of a linear formula which is also examined here.

- Simulations results of tariff reduction using the linear formula also indicate considerable differences in trade and welfare impacts across countries. Nevertheless, in contrast to the Swiss formula, the revenue impacts are more homogenous across countries and related positively to the initial level of tariffs. Reduction of tariffs according to the linear formula with a coefficient of 50 per cent yields global welfare gains comparable to those achieved with a Swiss formula with a coefficient of 10. The Swiss formula, however, yields more favorable revenue effects.

- As far as the distinction between agricultural and industrial products is concerned, lowering agricultural tariffs according to the Swiss formula with a coefficient of 10 results in globally higher welfare gains as compared to lowering of tariffs on industrial products. Developing countries as a group, however, gain more from liberalisation of industrial tariffs. This is because

on average these countries have high, and still increasing, shares of manufacturing in production, exports and imports. Impacts on developing countries' tariff revenue associated with lowering of tariffs in agriculture are relatively moderate and on average amount to 5%. A comparable Swiss formula reduction of manufacturing tariffs results in an average reduction of tariff revenue in developing countries by 20%.

- For the majority of countries in our sample, a more ambitious tariff cut (based on the Swiss formula) produces higher welfare gains but is also associated with higher percentages of forgone revenues. For some countries, additional welfare gains associated with a more ambitious Swiss formula coefficient are more "expensive" than for others in the sense that they induce a relatively high percentage loss of revenue accompanied by a relatively small percentage gain in welfare.

- The required fiscal adjustment will depend on a given percentage impact on tariff revenue and shares of tariff revenues in the total government revenue and GDP. Estimates for 12 countries in our sample indicate that in nine cases the potential tariff revenue reductions are relatively small and the required fiscal adjustment is therefore manageable, especially given the net efficiency gains that are expected to result from liberalization. In some cases, however, the required fiscal adjustment may be more extensive.

- The results of the simulation according to the Swiss formula where tariff revenue losses are replaced with consumption tax indicate that there is significant scope for obtaining positive welfare gains from the joint package of tariff and tax reform without compromising public revenue. Under certain conditions, an accompanying tax replacement policy would reduce only partially the welfare gains arising from improvements to resource allocation associated with tariff reform.

- Reliance on import duties as a source of government revenue differs considerably from country to country and so will the adjustment requirements associated with replacement of import duties with other revenues. Overall, the literature points to both successful and failed attempts at co-ordinating tariff and domestic tax reforms. However, neither the past successes should be regarded as a proof that the replacement of tariff revenues is unproblematic, nor the failures be taken as a confirmation that such reforms are impossible. The mixed evidence calls for a forward looking approach to addressing the adjustment costs that may be associated with tariff cuts agreed in the DDA negotiations. Such an approach should involve both an advance assessment of which countries may be particularly vulnerable as well as an integration of revenue concerns into SDT provisions be it in the form of extended implementation periods or coordinated financial assistance provided to disadvantaged developing countries to help them overcome financial, technical or capacity constraints associated with a tariff-cum-tax reform.

- It is worth noting that while the costs associated with the design and implementation of an appropriate (compensating) tax are temporary, the gains they induce through an improved allocation of resources are permanent. Therefore, from an economic point of view, these costs are seen not as an obstacle to liberalisation but rather as necessary investments that would pave the way for the realisation of long term gains.

I. Introduction

1. Tariffs influence trade, production, consumption patterns and welfare of not only the countries that impose them, but also the welfare of their trading partners. They do so through both the absolute levels of protection they impart and through distortions associated with their structure. In particular, tariffs create a wedge between domestic and world prices pushing demand towards domestically produced substitutes. Additionally, an uneven structure of tariffs distorts production and consumption incentives further preventing trading partners from capturing gains associated with their comparative advantages. Therefore, a non-discriminatory tariff liberalisation if accompanied by appropriate complementary policies (*e.g.* macroeconomic, social and labour market policies; see OECD, 2003) is generally expected to result in improved allocation of resources and to bring benefits to countries implementing the reform as well as to their commercial partners.

2. Developing countries that currently tend to maintain higher and more dispersed tariff barriers are particularly well positioned to benefit from a tariff reform package. Improvements to the allocation of resources, enhanced competition, wider product variety and benefits of scale economies associated with the tariff reform improve economic outcomes, and create a better base for implementing development and poverty reduction strategies.

3. The empirical evidence from recent literature shows that the potential gains from dismantling remaining tariff barriers are substantial (*e.g.* Francois et al., 2003; Cernat *et al*., 2002 or Dessus *et al*., 1998; Laird *et al.,* 2003). OECD (2003) provides an overview of existing estimates of welfare gains associated with tariff reduction. While these estimates vary depending on the assumed liberalisation scenario as well as the adopted methodological framework, a consensus has emerged that these gains are significant and that developing countries capture the largest gains relative to their GDPs. In this context, it is important for developing countries to actively engage in multilateral tariff liberalisation not least because they would obtain large gains from their own tariff liberalisation but also because by taking such steps they are more likely to gain better access to industrial countries' markets.

4. While most developing countries recognise the opportunities associated with improved market access, some have also pointed to the potential tariff revenue loss as a key obstacle to reducing their tariffs. Indeed, while the removal of quantitative restrictions, tariffication of quotas or reduction of non-tariff barriers all have the advantage of preserving or even increasing government revenue[1] without a major reform of the tax system [*e.g.* Ebrill *et al.,* (1999)], the same cannot be in general assumed about tariff reduction. In fact, a complete removal of tariffs will inevitably lead to a loss of tariff revenue and is likely to require a compensatory increase in other non-trade taxes. Tariff revenue loss cannot be a priori excluded even in cases of partial tariff reduction unless the expansion of the tax base following liberalisation is large enough to create sufficient compensation.

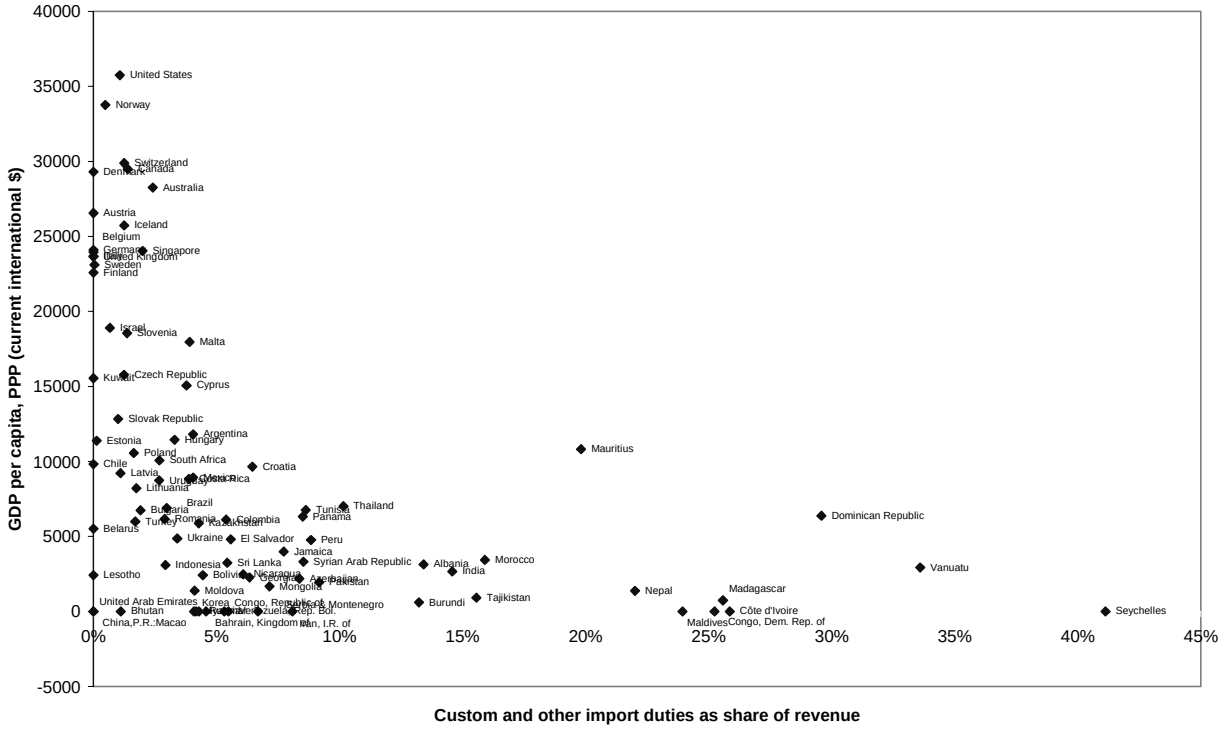
5. The need for co-ordination of tariff reforms with other tax policies is particularly evident in developing countries where, in several cases, trade taxes continue to account for significant shares of public revenues and GDPs (compare Figure 1 and Annex Table 1). Recent estimates suggest that, on average, trade tax revenues accounted for around 4% of low and middle income countries' GDPs in 1995-2000 while the equivalent estimate in high income countries was below 1%. The high shares of import duties in tax revenue imply that, should tariffs be completely abolished, many low income countries would have to extensively revamp their tax systems in order to replace on average around 18% (and in some cases more than 50%) of their revenue with revenues from sources other than import duty. In Least Developed Countries (LDCs) in Africa, import duties represented about 34% of total government revenue over the period 1999-2001 exceeding a 50% share in a number of countries (UNECA, 2003). In industrial countries,

[1] For example, additional revenue stemming from tariffication of quotas.

where the share of import duties typically does not exceed 2% of tax revenue, abolition of tariffs would not pose a major fiscal adjustment problem.

6. The importance of these differences between developing and developed countries is reinforced by the fact that countries at lower stages of development are often struggling to sustain their macroeconomic stability (of which fiscal sustainability is an important aspect) and face potential adverse effects of revenue reduction on poverty reduction[2], redistribution and development strategies. Potential revenue shortfalls can undermine economic programs and may result in a reversal of the trade reform itself. UNECA (2003), for example, reports that the pace of implementation of more outward-oriented development strategies in some African countries has been to a significant extent hindered by fiscal considerations associated with heavy reliance on trade taxes. Failure to take fiscal constraints into consideration can be one of the principal causes for unsuccessful trade reforms (IMF, 2003).[3] This highlights the need to accompany tariff reforms with policies designed to replace any potentially lost tariff revenue, ideally, in a less distortionary manner. Taking revenue concerns adequately into account when designing and implementing a tariff reform will undoubtedly facilitate the process of further multilateral tariff liberalisation.

Figure 1. Reliance on import duties and the level of development



Source : OECD Secretariat's calculations based on IMF Government Finance Statistics and World Development Indicators, customs and import duties and revenue refer to central government only, the reference period is the latest available year in period 1998-2003.

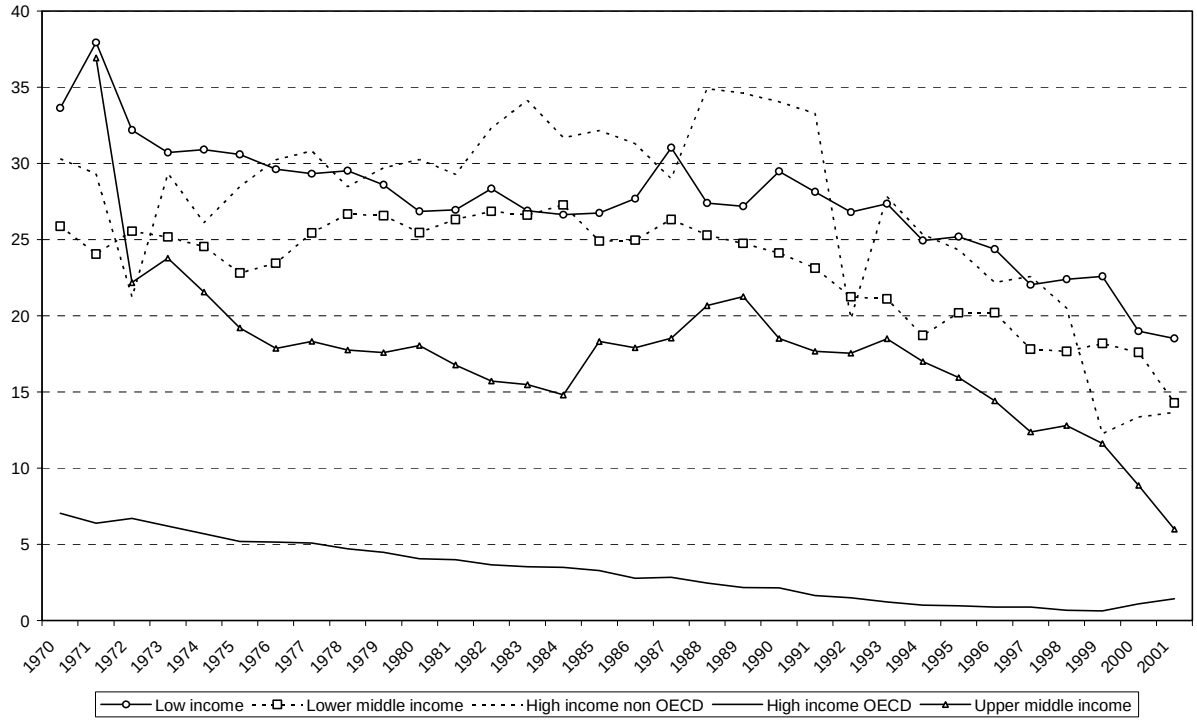
7. The recent policy advice in the area of fiscal implications of trade liberalisation stresses the use of other taxes as a compensating measure [IMF in WTO, 2003a, and the US in WTO, 2003d]. A shift away

[2] Hertel and Winters (2005) indicate that key determinants of the national poverty impacts include the incidence of national tax instruments used to replace lost tariff revenue.

[3] The other principal cause referred to in the IMF study is the impact of trade reform on the distribution of real income.

from trade taxes towards other forms of taxation such as income, sales or value added taxes has already been taking place for some time in many countries (Figure 2). In fact, the need to offset revenue losses from trade liberalisation by strengthening domestic taxation has in many cases been a key consideration in the adoption of the VAT (IMF, 2003).

Figure 2. Reliance on import duties by income groups, 1970-2001



Source : OECD Secretariat's calculations based on World Development Indicators database.

8. The recommendation to shift away from trade taxes towards domestic consumption and income taxes reflects the consensual view that trade taxes are a relatively inefficient way of raising revenue. Nevertheless, despite the theoretical argument for a simultaneous tariff and tax system reform, there exist considerable controversy with respect to the feasibility of such a strategy in developing countries whose ability to replace tariffs with indirect taxes has been questioned on structural and political-economy grounds. The literature points to both successful and failed attempts at co-ordinating tariff and domestic tax reforms. However, neither the past successes should be regarded as a proof that the replacement of tariff revenues is unproblematic, nor should the failures be taken as a confirmation that such reforms are impossible. A more complete discussion of these issues is presented in Section IV.

9. It is worth noting that the costs associated with the design and implementation of appropriate tax reforms are temporary while the gains they induce through an improved allocation of resources are permanent. Therefore, from an economic point of view, these costs are seen not as an obstacle to liberalisation but rather a necessary investment to enable the realisation of long term gains.

10. In summary, the existing literature points to the strong economic case for a non-discriminatory tariff reform that, where necessary, should be accompanied by a reform of the tax system. However, it does also point to sensitivities associated with the fiscal implications of tariff liberalisation in developing countries that need to be addressed either by an appropriate design of tariff reduction modalities and/or by providing assistance in the implementation of a tariff-policy-cum-tax-reform package. Since the revenue

impact of tariff liberalisation depends on the initial structure of tariffs, the design of the liberalisation scenario and the overall impact of liberalisation on production, consumption and trade, it is not evident which developing countries may be affected by a tariff revenue loss and to what extent. The existing literature does not offer a comprehensive empirical investigation of the magnitude of the revenue impacts that may be expected at the conclusion of the ongoing round of trade negotiations.[4] This paper attempts to fill this gap by providing empirical estimates and analysis of the nature and scope of this problem with the objective of facilitating the DDA negotiations.

11. First, the paper provides a discussion of the global pattern of tariff protection devoting special attention to developing countries' tariff profiles as they affect both their level of protection and their fiscal situation. Second, the paper outlines the DDA work in the area of tariffs and discuss the various formula approaches to tariff reduction used in past rounds of multilateral trade negotiations. A discussion of tax reform policies that could accompany tariff reform and lessen potential revenue losses follows. In the empirical part, we describe a methodology that can be used to estimate the impact of tariff liberalisation on government revenues, present results of simulations of tariff revenue and welfare effects using the linear and Swiss tariff reduction formulas for a sample of 24 developing countries. Based on our empirical findings we discuss cross-country differences in revenue impact as well as provide sensitivity analysis with respect to three different coefficients in the Swiss formula (5, 10 and 15). Additionally, we provide a discussion on revenue, trade and welfare properties of tariff reduction formulas. Finally, the paper offers an estimation of the welfare effects of reducing tariffs and simultaneously replacing lost tariff revenue with revenues from consumption tax. It concludes with some policy implications and caveats.

II. Post-Uruguay Round structure of tariff protection

12. Despite remarkable reductions in tariffs following eight consecutive rounds of negotiations under the auspices of the GATT, market access continues to represent one of the most important trading issues between OECD and non-OECD countries (OECD, 2001). Market access remains one of the core areas of work for WTO members in the context of the multilateral trade negotiations launched at the 4th Ministerial Conference in Doha. Both developing and developed countries' demands are for increased access to partner markets. However, as will become evident below, their different starting points and abilities to implement trade reforms may help explain some of the dynamics surrounding the current tariff negotiations.

Tariff profiles by region

13. In general, developing countries tend to impose higher tariffs on imports of both agricultural and non-agricultural products (Annex Tables 2a-2h). Particularly high MFN rates are levied on imports in low and middle income countries of North Africa, the Middle East, and South Asia. The gap in MFN tariff rates between developed and developing countries was reinforced by the Uruguay Round that resulted in average tariff reductions among OECD countries of 45%, as compared to 30% among non-OECD countries [OECD, 2001].

14. As discussed in OECD (2003), high tariffs imposed by developing countries not only restrict access of exports of developed countries but also that of other developing countries thereby impeding South-South trade. While certain qualifications need to be kept in mind when using trade weighted tariff averages[5] as indicators of trade restrictiveness, they do indicate that, especially in the agricultural sector, tariffs imposed by both LDCs and low and middle-income countries on imports originating from other low-income countries are on average significantly higher than those imposed on imports from high income

[4] An exception here is Laird *et al.* 2003 who provide a range of estimates.

[5] In this methodology, low trade values, which may be themselves a result of trade restrictiveness, imply low weights.

countries (Annex Tables 2b- 2e). For example, the average trade-weighted tariff imposed by LDCs on agricultural imports originating from other LDCs is 18.9% while that imposed on imports from developed countries is 10.8%. This suggests that high tariff policies in developing countries in addition to restricting access for developed countries' products have a disproportionately harmful effect on South-South trade. The tariff profiles of developing countries are also characterised by a higher dispersion of tariff rates (Annex Table 2g). This is also compounded by a more widespread incidence of international tariff peaks (*i.e.* tariffs exceeding 15%)[6] in developing countries as compared to developed countries (Annex Table 2h).

Tariff profiles by sector

15. In general, both in developing and developed economies, tariffs tend to be higher on imports of agricultural products as compared with industrial products (see Annex Tables 2b to 2e). [7] The agricultural sector also suffers from a higher incidence of tariff peaks. The world average agricultural bound (applied) tariff is estimated at 62 (17) % level as compared to 29 (9) %for industrial products (WTO, 2003). As can be seen in Annex Table 2a, import duties levied on agricultural products by low and middle income countries (22.6%) and LDCs (16.6%) are significantly higher than those imposed by developed countries (7.5%). The bias in the tariff profile towards high rates on agricultural imports is a consequence of exclusion of agriculture from multilateral trade negotiations prior to the Uruguay Round (UR). The modality for cuts agreed in the UR converted non-tariff barriers into tariff barriers which often resulted in setting high initial rates (WTO, 2003e). It has to be pointed out that assessment of protection levels in the agricultural sector is further complicated by the presence of tariff rate quotas (TRQs) with differential tariff rates inside and outside of the quotas as well as specific duties.

16. Similarly to the geographical patterns observed in the agricultural sector, estimated average tariffs imposed on industrial products by low and middle income countries (11.1%) and LDCs (13.2%) are much higher than those imposed by developed economies (3.8%) (see Table 2a). However, in contrast to the agricultural sector where almost all tariff rates are bound, the binding of tariffs in industrial goods still remains a negotiating issue. For example, many African and Asian countries have bound only a limited number of tariff lines (WTO, 2003e). In general, industrial tariffs are lower than agricultural ones; however, there is a considerable degree of heterogeneity within the industrial product categories. Bacchetta and Bora (2003) report that simple average bindings in textiles and clothing, leather, rubber, footwear and travel goods, transport equipment and fish and fish products are significantly higher than those on other industrial products. As far as applied rates are concerned, textiles and clothing have the highest or the second highest applied tariff averages in most countries. This sector is also reported to have the highest incidence of international tariff peaks (WTO, 2003e).

Tariff Dispersion

17. As with the levels of tariffs, tariff dispersion varies significantly across regions and across sectors. Developing countries' tariff schedules generally tend to be less uniform as compared to developed countries (Annex Table 2g). Additionally, coefficients of variation of tariff rates in agricultural sectors significantly exceed those in industrial products including in developed countries where the dispersion of tariffs reaches levels observed in some developing regions (Annex Table 2g). However, it is worth noting

[6] 15% is the definition of an international tariff peak used commonly in the WTO context.

[7] Despite agricultural tariffs being generally higher than tariffs on industrial goods several categories of agricultural products enjoy relatively low tariff rates. These include: coffee, fibre, spices, live horticulture (WTO, 2003). Similarly, a few countries do not conform to the general pattern and levy lower import duties on agricultural products than they do on industrial goods. Among them are Australia and New Zealand and Switzerland has a zero tariff policy in both sectors.

that tariff dispersion does not per se indicate an irrational tariff policy. In fact, in some cases it may indicate a fine-tuned tariff policy where imports are taxed differently depending on their sensitivity to price changes, different levels of optimal tariff rates in cases of large countries that can affect world prices or taxation of monopolies. Nevertheless, high dispersion of tariff rates or practices such as tariff escalation whereby tariffs increase according to the degree of processing may lead to higher effective protection. Similarly, high levels of effective protection can result from a tariff structure where high nominal rates are stratified along the different stages of production. IMF and World Bank (2002, p. 14) indicate that "[t]he pattern of protection creates particular hurdles for countries taking the first steps up the technology ladder". Finally, highly dispersed tariff rates are often associated with complications with collection of these duties.

Bound versus applied tariffs

18. While so far this paper has focused on applied MFN rates as those directly affecting trade flows, it is crucial to distinguish them from bound tariffs that are at the centre of the WTO market access commitments. The distinction between applied and bound rates is important due to considerable differences between bindings and applied rates (binding overhangs) which bear implications for the trade, welfare and revenue impacts associated with any tariff reduction agreed in the WTO.

19. As a result of commitments under the Agreement on Agriculture, the binding coverage in the agricultural sector is close to 100%[8] which is in contrast to industrial products where a number of (mostly) developing countries have chosen not to bind all their tariff lines and where the binding of tariffs remains a negotiating issue. At the same time, as a result of the tariffication process in the UR (see above) binding overhangs tend to be very high in the agricultural sector. As a general rule, bound rates tend to be more uniform as many countries set uniform rates across a wide range of products (Annex Table 2g).

20. Differences between bound and applied rates are particularly large in LDCs where, expressed as a percentage of their applied duties, they reach 365% in agricultural products and around 290% in industrial products (Annex Table 2f). In addition, as mentioned earlier, many industrial tariff lines are not bound which makes it possible that the reported overhangs underestimate the extent of uncertainty with respect to commercial policy. Among lower and middle income countries, the existing overhangs expressed in relative terms are highest in Latin America and Caribbean, East Asia and Pacific and in the agricultural sectors of South Asia. Developed countries maintain single digit overhangs which are, however, significant if expressed as a percentage of the corresponding applied rate.

21. Larger binding overhangs in developing countries require bolder tariff cuts in order to obtain reductions in applied rates. Indeed, the binding overhang is estimated at three times the average applied rate in the agricultural sectors of South Asian low and middle income countries (Annex table 2f); this implies that on average the bound rates would have to be cut by as much as 75% if it were to have an impact on applied rates. This highlights the need to have a robust formula in the context of the Doha round of negotiations in order to secure real market access and resulting welfare gains for participants. At the same time, large binding overhangs imply that unused protection can be significantly reduced contributing to greater certainty about the future levels of tariff protection without implying any losses to government tariff revenue. In fact, binding of unbound lines and reduction of existing binding overhangs may positively affect trade flows and revenue collection by providing an upper ceiling on applied rates and thereby constraining the uncertainty with respect to future protection levels (see Box 1).

[8] Twenty three countries have bound approximately 99% of their tariff lines (WTO, 2003).

Box 1. Economic value of reducing binding overhangs

Francois and Martin (1998) and Hertel and Martin (1999) argue that even tariff bindings above the current rates have an economic value. Any cut in the binding reduces the uncertainty about the future level of protection by compressing the margin within which the applied rates can fluctuate.

Francois and Martin (1998) show that if applied rates vary stochastically within the permitted band set by a tariff binding and the distribution of a tariff rate within this interval can be approximated by a time-invariant normal distribution, the introduction of a tariff binding will both reduce the mean and the variance of the tariff rate. The nature of these relationships between the mean and the standard deviation before and after the introduction of a binding is a non-linear one: expected tariffs and their standard deviations do not change one for one with the lowering of the binding. This marginal impact increases as the introduced binding approaches the current mean. They also show that the variance of protection maps directly into the welfare impact of protection and argue that GATT-type restrains on protection policy are preferred over protection which is free to vary in an uncontrolled manner.

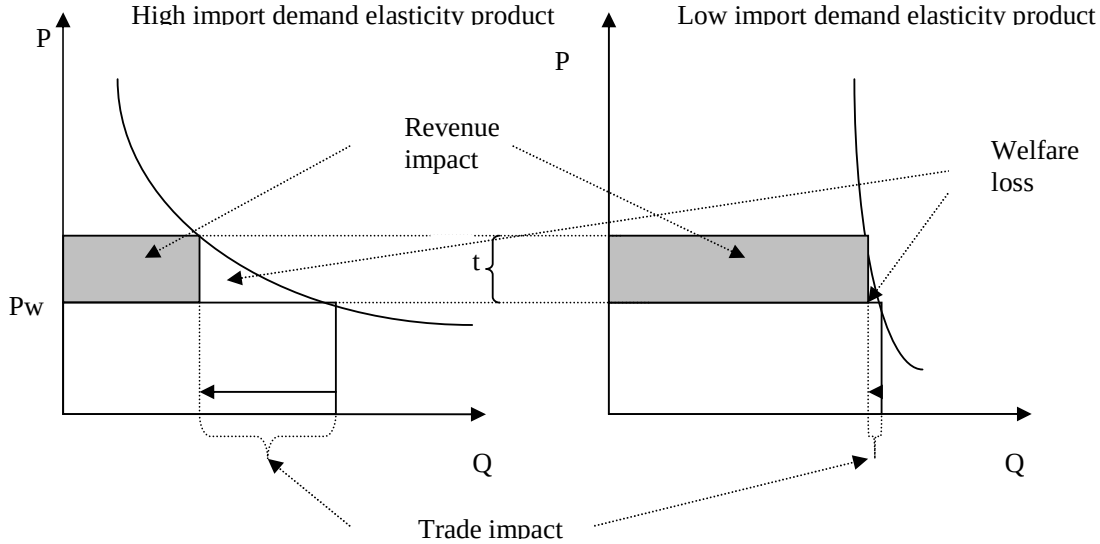
As an implication, Francois and Martin (1998) stress the role of the perceived benefits of reductions in the uncertainty confronting exporters regarding the commercial policy; they thus suggest rewarding countries with negotiating credit for tariff bindings at or in the neighbourhood of the currently applied rates.

Protective and fiscal goals of tariff policies

22. Notwithstanding their welfare implications, tariffs have traditionally been used in developing countries to achieve multiple goals such as raising public sector revenue, correcting market distortions, providing protection for local industry, improving terms of trade by attempting to influence world market prices and redistributing income (Khattry and Rao, 2002). Whatever the broader goals of such policies are, for analytical purposes they can be divided into two broad goals: that of raising public revenue (fiscal measure), and that of regulating trade through affecting the volumes of imported merchandise (protective measure).

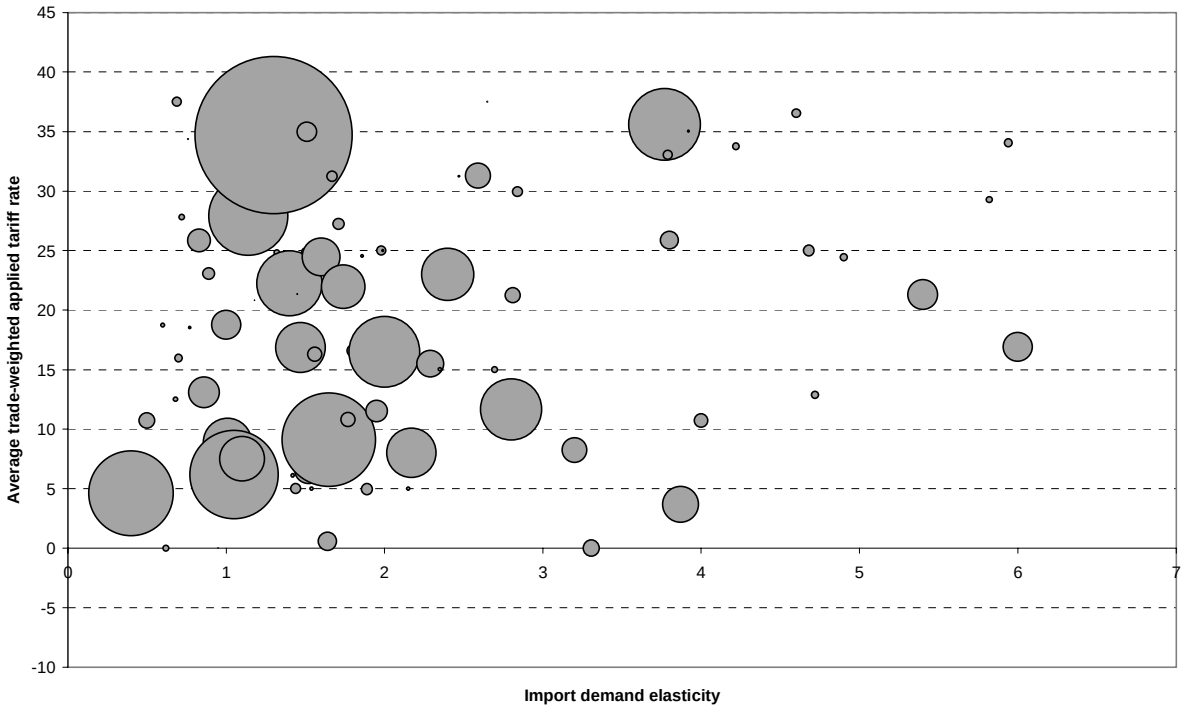
23. In fact, the fiscal and protective roles of tariff policy are to some extent two competing policy objectives. This is illustrated diagrammatically in Figure 3 where the revenue implications of a given ad valorem import duty are maximised in cases in which its impact on the trade flow and welfare is minimised. Technically, these are sectors with low price elasticity of import demand where the tax base (or the value of imports in this case) does not deteriorate by much as a result of higher import duty. If price elasticity is high, demand for imports would fall significantly thereby hampering or even overturning the impact of an increase in the tax rate. If imports are price inelastic, the change in tariff does not affect imports, and increases in the tariff rate will translate fully into higher revenues. It has to be pointed out that in this simple framework there is no trade-off between the trade and welfare objectives. A given tariff imposed on a low import demand elasticity product will result in a small welfare loss and a small reduction in imports as compared to an equivalent tariff imposed on a price elastic product (compare the welfare loss triangles in Figure 3).

Figure 3. Trade restriction and revenue collection as alternative goals of tariff policy



24. In order to get a bird's eye view on how the selected developing countries are pursuing these two objectives of tariff policy, we plot average applied tariffs against the estimated import demand elasticities (Annex Figure 1). To facilitate the discussion, Figure 4 below presents the case of Bangladesh. In Bangladesh, as in most other analysed cases, price elastic goods are mostly tariffied at high levels implying the pursuit of the trade protection objective. Second, there is a considerable dispersion of tariff rates imposed on price inelastic goods which is only partially consistent with the objective of revenue collection. Overall, Bangladesh's case indicates that there is scope for freeing trade without actually compromising tariff revenue. For example, currently high tariff rates on price elastic goods could be lowered significantly, boosting trade flows (and welfare) and having a minimum impact on revenue. Indeed, in the case of Bangladesh the price elastic products charged with high rates record relatively small import values (small size of the bubbles). At the same time, applied tariff rates on price inelastic products could be raised within the bound limits to compensate for any revenue loss that might have occurred from lowering rates on price elastic products. In this way efficiency and welfare could be increased through a more uniform tariff profile without affecting the level of collected revenue.

Figure 4. Bangladesh: average applied tariff rate and import demand elasticity.*



(*) The size of bubbles indicates the shares in imports value.
Source : WITS for tariff, trade and elasticity data and OECD Secretariat's calculations

25. While the tariff rate-import demand elasticity patterns vary from country to country, as can be seen from Annex Figure 1, the high dispersion of tariff rates in low elasticity sectors and the prevalence of high tariff rates in high elasticity sectors is a rather common characteristic in our sample. This suggests that the analysis of Bangladesh's case can be extended to other countries where tariff profiles could possibly be rationalised so that access to markets is improved, distortions associated with tariff policy minimised and tariff revenue preserved. As discussed above, this would have to involve decreasing dispersion of tariff rates on price inelastic goods and lowering of tariff rates on price elastic goods.

26. A prominent qualification associated with the option discussed above is that it would necessarily have to involve increasing some tariff rates on low import demand elasticity merchandise where the revenue would be generated with little impact on trade and welfare. Essentially such a reform would mean a move towards a more uniform tariff. In addition to a mitigated impact on revenues, other advantages of a more uniform tariff schedule include simplicity and reduced opportunity for evasion.[9] Additionally, a strong commitment to uniformity can serve as a defence against lobby group pressures for special treatment (Panagariya and Rodrik, 1993). Nevertheless, despite these practical arguments, the theoretical case for a uniform tariff is less clear-cut for it cannot be guaranteed that lowering the highest tariffs while at the same time increasing the lowest ones will be welfare improving. Whether this is the case is country-specific and depends, in addition to the tariff structure and import demand elastcities, on the input-output

[9] With multiple tariff rates, items can be misclassified into lower tariff bands (Gourjon in IMF (2003). Some evidence for this is provided by Fishman and Wei (2002) for trade between Hong-Kong and China.

links within the economy (see *e.g.* Gourjon in IMF, 2003).[10] The latter aspect has not been taken into account here.

27. Finally, movement toward the uniform rate does not have free trade as its logical end-point, and is against the sprit of the Doha round. In any case, increases in applied rates where binding overhangs permits are outside the scope of multilateral negotiations and, hence, beyond the scope of this paper. The lesson that should be drawn from analysis in paragraphs 27-31 is rather that the current tariff structures seem to indicate relatively mitigated revenue impacts of tariff reduction as compared to the situation where high rates would prevail on low elasticity products.

28. In contrast to applied rates, Annex Figure 2 indicates that in a number of developing countries (*e.g.* India, Bangladesh, Malawi, Uganda, Zimbabwe, Colombia) bound rates tend to be high in few low import demand elasticity sectors. This suggests that by keeping high binding overhangs in low import demand elasticity sectors these countries maintain an option of raising the applied tariff rates on lines where they would only have a limited trade impact but could effectively raise additional revenue. Such an option could be used in the wake of a macroeconomic shock that would undermine the fiscal or balance of payments stance. The corollary to this is that there exists a scenario where a revenue neutral reduction of bound rates to the level of applied rates could constrain countries' flexibility to adjust to macroeconomic shocks. As explained above, such an option comes at a cost of higher uncertainty about future protection levels. Moreover, tariff policy is considered to be ineffective in pursuing the balance of payments objectives. De-linking of tariff policy as well as development and implementation of alternative measures have long been at the centre of the IMF and WB efforts. The prospect of further reduction of tariffs as a result of the DDA underscores the important role that the two institutions could play in responding to any potential balance of payments concerns.

III. Formula approaches to tariff reductions

29. Although tariff reductions can be achieved in a discretionary way by negotiating concessions in individual countries and sectors, the practice of multilateral and regional trade negotiations indicates that the formula approach to obtain commitments across countries and sectors enhances the probability of success. The formula approach limits the role of special interest groups, facilitates monitoring of the balance of concessions and enables effective participation of smaller countries that would not otherwise be able to effectively negotiate bilateral deals. Francois and Martin (2003) point to the effectiveness of a formula approach by comparing a 35% reduction in average tariffs in the Kennedy Round when a 50% proportional formula was agreed with the average of 2.5% in the second through the fifth rounds of GATT negotiations conducted under the request and offer approach.

30. The ongoing WTO negotiations on market access in both agricultural and industrial products aim to reach agreement on a framework that applies to all members, provides real market access commitments and incorporates special and differential treatment tailored to the needs of developing countries. As far as tariff reduction formulas are concerned, however, the WTO gives members substantial flexibility with respect to how tariffs may be lowered. Box 2 and Figure 6 discuss a number of tariff reduction formulas that have been used in the past rounds of multilateral trade negotiations or described in the trade policy literature.

31. In the past, a number of approaches to tariff cuts were used or discussed. The initial tariff negotiations under the GATT followed the *request-and-offer* procedure where members negotiated

[10] At the same time, existing simulation results suggest that the loss of welfare associated with employing a uniform tariff structure rather than one that rises the same amount of revenue in the most efficient way is likely to be relatively small (Gourjon in IMF, 2003).

bilateral market access concessions and subsequently extended them to all members following the MFN principle. A *linear formula* approach was introduced in the Kennedy Round (1963-67) where a 50% cut was agreed on all manufactured goods with exceptions for sensitive goods including steel, clothing, textiles and footwear. The *linear formula* has the property of yielding higher absolute cuts of initially high tariffs (Panagariya, 2002)[11] as well as higher proportional reductions of duty-paid prices on high tariff items which in principle leads to economic efficiency. However, the undesirable property of the *linear formula* is that both high and low rates are cut in the same proportion thereby carrying over the initial dispersion across sectors and countries.[12]

32. The *Swiss formula* adopted in the Tokyo Round has a number of desired properties. It maintains the advantage of the *linear formula* of decreasing high tariffs by more in absolute terms but it also does so in relative terms offering a more effective reduction of tariff dispersion. Additionally, the coefficient *a* in the *Swiss formula* provides an upper ceiling on the maximum post-reform tariff rate. Another approach that leads to higher proportional cuts in higher tariffs which was considered in the Tokyo Round is the *general linear approach*. Unlike the Swiss formula, this approach implies that some low rates may actually be increased (see Figure 6). Proponents of this approach in the Tokyo Round advocated that it be applied only to tariffs greater than five% (Francois and Martin, 2003, citing Laird and Yeats, 1987).

33. The Uruguay Round approach involved setting broad tariff reduction goals such as a 30% average reduction on industrial products, but leaving the distribution of the cuts across sectors up to negotiations. This approach brought about substantial tariff reductions but was less successful in achieving higher proportional cuts in higher tariffs and in lowering dispersion (Francois and Martin, 2003). The Uruguay Round agreement on agriculture also included a range of formula-type elements such as average cuts in tariffs, a minimum cut in each tariff line; formulas for establishing bindings and ceiling bindings options.

34. Other formulas discussed in the literature include the so called *flexible Swiss formula* (Francois and Martin, 2003) and the formula that defines liberalisation in terms of the foregone tariff revenue (Panagariya, 2002). The flexible Swiss formula, in addition to preserving the attributes of the standard Swiss formula of the uniform maximum equal to the *a* parameter and higher proportional cuts to higher rates, introduces more flexibility with respect to the depth of cuts. The key practical advantage of such a formula, as argued by Francois and Martin (2003), is that the impact of tariff reductions on peak tariffs can be moderated by adjustments to the parameter *a* while compensating the trading partners through reductions in lower tariffs (by adjusting the *b* parameter) sufficiently to achieve a target reduction in the average tariff (see Box 2 for more details). If the objective is to keep the percentage reduction in average tariff constant then the choice of a higher maximum tariff would require larger reductions in the relatively low rates.

35. The tariff revenue formula takes into account both the initial tariff rate and the share of the country's trade in the world market (see Box 2). To achieve the same level of liberalisation, a country that imports larger volumes of a particular good and imposes a higher initial tariff has to liberalise proportionately less to achieve the same level of liberalisation.[13] If the initial level of tariff in a sector is low, the credit given for a given percentage reduction is also low (see Panagariya, 2002). This formula is

[11] More protected sectors are liberalized more in absolute terms. Additionally, effective protection is unlikely to raise because input tariffs decline proportionately more than output tariffs.

[12] Technically, a proportional cut in tariffs does not decrease the coefficient of variation (the ratio of standard deviation to the average) of tariffs.

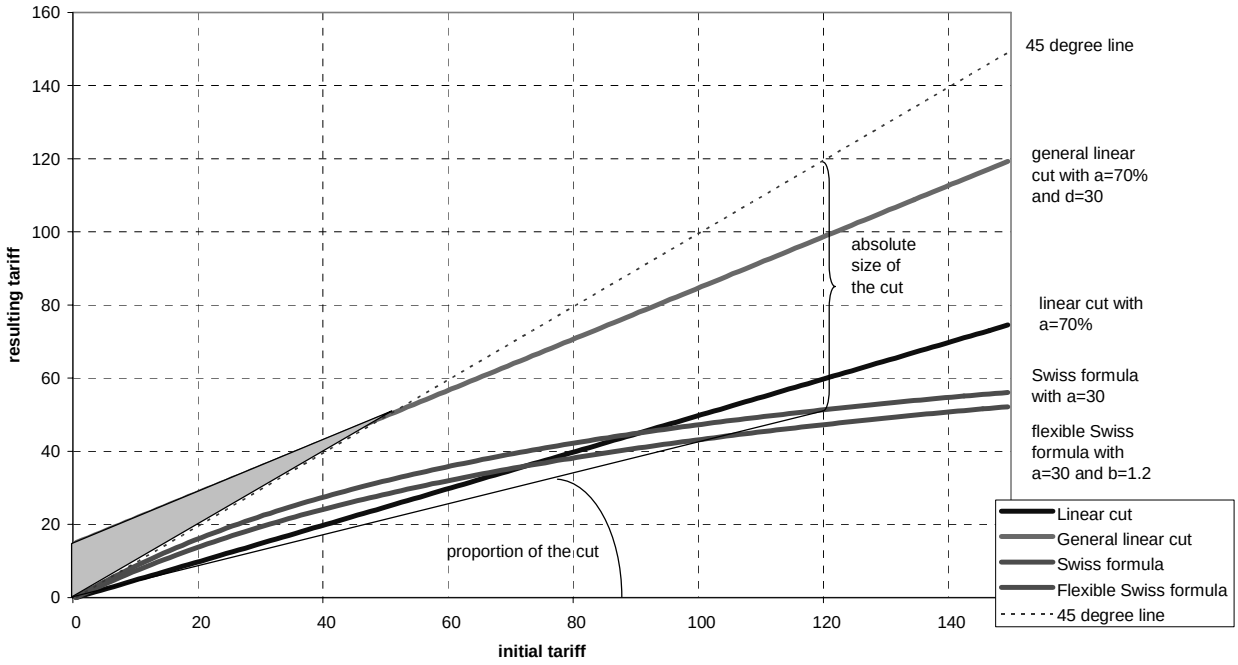
[13] While the liberalisation in this type of formula is defined by the size of the revenue forgone the formula does not account for the fact that the revenue impact dos not depend just on the initial trade and protection but also on trade elasticities.

effective in terms of balancing the bargains between member countries; but for a given level of trade, the formula implies lower proportionate reduction in tariffs whenever the initial tariff is high which may be an undesirable outcome from an efficiency point of view.

Box 2. Selected formula approaches to tariff cuts

	Formula	Description
Simple linear approach	$T_{i1}=aT_{i0}$	T_{i1} and T_{i0} are the final and initial tariff respectively and $0<a<1$, subject to negotiation, is a percentage reduction in tariff which is constant for all initial tariffs $T_1/T_0=a$.
General linear approach	$T_{i1}=d+ aT_{i0}$	*d* is a positive constant and $0<a<1$. This approach leads to larger percentage reductions in higher tariff rates but could also lead to increases in the lowest rates.
Swiss formula	$T_{i1}=aT_{i0}/(a+T_{i0})$	*a* is the negotiated coefficient and the level of maximum resulting tariff. This formula implies higher percentage cuts for high rates but does not require increases in the lowest rates.
Flexible Swiss formula	$T_{i1}=aT_{i0}(a*b+T_{i0})$	This formula maintains the attribute of the standard Swiss formula where *a* sets a maximum resulting tariff but it also permits additional flexibility through *b:* as *b* increases the formula tends to increase the reduction in the lower tariffs allowing for higher maximum rates with the same target reduction in the average tariff (source paper: Francois and Martin, 2003)
Tariff revenue formula	$T_{i1}=c/T_{i0}*V_{i0}$	*c* is a constant and V_{i0} is the value of initial imports at world prices

Figure 5. Formulas for tariff cuts: relationship between initial and resulting tariffs



Revenue properties of tariff reduction formulas

36. At the tariff line level, the revenue impact of tariff reduction depends on:

- the initial trade value;
- the level of initial tariff;
- the responsiveness of trade volumes to price changes (import demand elasticity), and
- the absolute size of the tariff cut (for details see Technical Annex).

37. The aggregate impact on tariff revenue in a given country is the sum of tariff line impacts. The chosen formula and its parameter(s) determine the sizes of the absolute and proportional cuts across the entire tariff schedule. Since tariff and trade profiles vary widely from country to country, it is difficult to know a priori which tariff reduction formula can be most effective in preserving revenue given a certain ambition of trade liberalisation. Nevertheless, once again, the main objective of trade liberalisation is to enhance allocative efficiency (and hence welfare), and not to preserve government revenue.

38. As discussed in the empirical part of the paper, countries in our sample differ less with respect to trade weighted average import demand elasticity as compared to differences in initial trade weighted average tariff levels. Therefore, it is possible to get an insight into trade creation and revenue implications of alternative tariff reduction formulas by assuming a uniform import demand elasticity across the entire tariff schedule within a country and by comparing how trade and revenue effects depend on the initial tariff level. The Technical Annex offers such analysis for the *linear* and *Swiss* tariff reduction formulas. We find that if two countries are characterised by the same import demand elasticity but maintain different initial

tariff levels, a linear formula implies that the high tariff country will experience a smaller percentage revenue loss and a larger percentage increase in imports as compared to a low tariff country.

39. The latter result does not obtain when the Swiss formula is used. For certain ranges of initial tariffs, a high tariff country may experience a larger percentage revenue loss than a low tariff country (see Technical Annex for details and graphical illustration). Indeed, when the Swiss formula coefficient is set at 15 and import demand elasticity is assumed to equal 2 (*i.e.* approximately the mean of trade weighted country averages in our sample) this relationship is negative, implying that a high tariff country will experience a deeper proportional loss of revenue. This result is confirmed by the simulations which are presented later on in the paper.

Tariff reductions in the Doha Work Programme

40. The Doha Ministerial Declaration recognises the importance of continued progress in reducing key tariff-related distortions and contains an explicit statement with respect to the negotiating mandate on non-agricultural tariffs.[14] Although the Doha Declaration does not specifically mention agricultural tariffs, it does express the intention to improve market access in this sector.[15] In fact, the ongoing negotiations are addressing agricultural tariff issues, including the extent to which average tariffs should be cut and the need to progressively reduce high tariffs and tariff escalation. More broadly, market access is seen as an area that is likely to drive the success of the WTO negotiations as one offering most significant global gains to both developing and developed WTO members as well as one that will enable a balanced distribution of gains.[16] Most WTO member countries support the Doha mandate to improve market access through tariff reductions. Nevertheless, certain developing countries are concerned about the loss of tariff revenue, adverse terms of trade effects, potential erosion of preferential access margins and the overall distribution of gains from this reform.

41. In the lead up to the Cancún Ministerial, the work of the WTO Negotiating Group on Market Access (NGMA) focused on the issue of "modalities" and particularly on a harmonising formula for tariff cuts applied on a line-by-line basis. Several countries submitted proposals outlining a range of market access priorities (WTO, 2003c) including the NGMA Chairman's proposal (WTO, 2003b). Nevertheless, a consensus could not be reached.

42. The meetings of NGMA in the run up to Cancun revealed different levels of ambition among Members with respect to how deep tariff cuts should be.[17] Significant North-South differences on tariff liberalisation and special and differential treatment aspects of the proposal emerged. For some developing countries, the proposal was going too far and did not sufficiently address their concerns. For many developed countries, on the other hand, the proposal would not guarantee effective improvement in market access. A number of proposals drew attention of the negotiating group to exemptions of sensitive products in the cases of vulnerable economies. Concerns were also raised about the need to preserve the existing margins of preference for developing country exports (see OECD 2004 for a detailed discussion of the preference erosion issues). Finally, the progress in NGMA negotiations was also held back by uncertainty about the level of ambition in agriculture negotiations.

[14] See paragraph 16 of the Declaration

[15] See paragraph 13 of the Declaration

[16] Letter of the US Trade Representative Robert B. Zoellick to Ministers (11 January 2004).

[17] As far as sectoral approach (i.e. the seven sectors proposed for a complete elimination of tariffs) is concerned, positions were far apart. A number of developing countries would see a voluntary approach to participating in these sectoral tariff reductions, while developed countries showed a preference for it to be mandatory.

43. The July Framework Agreement[18] specified the initial elements for future work on modalities by the NGMA. The Agreement preserved all the elements of the original Annex B from the Cancún Draft Ministerial text [19], including the explicit reference to (WTO, 2003b) as a reference for future negotiations, but included an opening paragraph which stipulates that additional negotiations would be required to reach agreement on the specifics of these elements. In particular, the July Framework agreement reaffirmed that the negotiations will continue to focus on a non-linear formula approach to tariff cuts applied on a line-by-line basis which shall take fully into account the special needs and interests of developing and least-developed country participants, including through less than full reciprocity in reduction commitments. Annex A - a framework for establishing modalities in agriculture has not referred to any specific formula but specified that "progressivity in tariff reductions will be achieved through deeper cuts in higher tariffs with flexibilities for sensitive products".

IV. Theory and practice of co-ordination of tariff and tax reforms

44. Openness to trade has long been established as an important element of good economic policy, and trade liberalisation as a necessary step for achieving it. Trade liberalisation enhances efficiency (including allocative efficiency, scale efficiency, technical and x-efficiency), and thus promotes economic development. Some developing countries have, however, expressed concerns that on the steps towards openness, trade liberalisation through tariff reduction impacts negatively on government revenues. This paper addresses these concerns by examining in what follows the theoretical arguments and the empirical evidence on the impact on government revenues of past reductions in tariffs.

45. The welfare gains from tariff reduction are the sum of gains to consumer and producer surpluses net of revenue loss. Such a definition, however, does not entail a valuation of services that can only be provided by governments through collecting and spending public revenue. Even though, in principle, almost any kind of taxation is distortionary, governments raise revenues with the objective to provide various public services, to ensure macroeconomic stability and to promote outcomes such as poverty reduction and income redistribution. The rationale for tariff cuts is thus important but so is the integration of the recommendations for tariff reforms with other objectives of economic policy including objectives of public finance.

46. The need for co-ordination of tariff reforms with other tax policies is particularly evident in developing countries where, in several cases, trade taxes continue to account for significant shares of public revenues and GDPs (compare Figure 1 and Annex Table 1). Recent estimates suggest that, on average trade tax revenues accounted for around 4% of low and middle income countries' GDPs in 1995-2000 while the equivalent estimate in high income countries was below 1% (Keen and Baunsgaard, 2004).

47. The high shares of import duties in tax revenue imply that, should tariffs be completely abolished, many low income countries would have to extensively revamp their tax systems in order to replace on average around 18% (and in some cases more than 50%) of their revenue with revenues from sources other than import duties. In Least Developed Countries (LDCs) in Africa, import duties represented about 34% of total government revenue over the period 1999-2001 exceeding a 50% level in a number of countries

[18] *Doha Work Programme: Decision Adopted by the General Council on 1 August 2004*, WT/L/579, World Trade Organisation, Geneva, 2 August 2004.

[19] *Draft Cancún Ministerial Text, Second Revision*, JOB(03)/150/Rev.2, World Trade Organization, 13 September 2003.

(UNECA, 2003).[20] In industrial countries, where the share of import duties typically does not exceed 2% of tax revenue, abolition of tariffs would not pose a major fiscal adjustment problem.

Box 3. The quality of data on trade and other tax revenues

According to IMF sources (Keen and Baunsgaard (2004)) the quality of the data on revenues in general, and trade taxes in particular, is poor. The IMF's Government Finance Statistics – the only comprehensive source of data on government finance comprising non-OECD countries – in addition to numerous data gaps, suffers from a problem of inclusion of the VAT and other sales taxes collected at the border as trade tax revenue. This problem is reported to be most severe in African countries.

48. The importance of these differences between developing and developed countries is reinforced by the fact that countries at lower stages of development are often struggling to sustain their macroeconomic stability (of which fiscal sustainability is an important aspect) and face potential adverse effects of revenue reduction on poverty reduction, redistribution and development capacity. Potential revenue shortfalls can undermine economic programs and may result in a reversal of the trade reform itself. UNECA (2003), for example, reports that the pace of implementation of more outward-oriented development strategies in some African countries has been to a significant extent hindered by fiscal considerations associated with heavy reliance on trade taxes. The IMF (2003) study reveals that the failure to take fiscal constraints into consideration is one of the principal causes for unsuccessful trade reforms.[21] Commenting on the study prepared by the Pakistan Institute of Development Studies and funded by the World Bank, Rajarm (1992) reports that tariff recommendations were not accepted by the government of Pakistan because in its view inadequate attention was paid to the revenue and employment effects. These examples make it clear that tariff reforms should be accompanied by policies designed to replace any potential loss in tariff revenue, ideally, in a less distortionary manner. Taking revenue concerns adequately into account when designing and implementing a tariff reform should facilitate the process of further multilateral tariff liberalisation.

Recommendations for a tax reform

49. The recent policy advice in the area of fiscal implications of trade liberalisation stresses the use of other taxes as a compensating measure [IMF in WTO, 2003a, and the US in WTO, 2003d]. A shift away from trade taxes towards other forms of taxation such as income, sales or value added taxes has already been taking place for some time in many countries (Figure 2). In fact, the need to offset revenue losses from trade liberalisation by strengthening domestic taxation has in many cases been a key consideration in the adoption of the VAT (IMF, 2003). Several developing countries have made significant progress with reducing their reliance on import duties as a source of tax revenue (*e.g.* 20 percentage points reduction in Tunisia, 17 in Jordan, 16 in Pakistan, 14 in Mauritius and Congo over the period 1994-2001.[22]

50. The recommendation to shift away from trade taxes towards domestic consumption and income taxes reflects the consensual view that trade taxes are a relatively inefficient way of raising revenue. As Whalley (2002) explains, trade taxes distort both consumption and production decisions and apply to a relatively narrow base. Since at the aggregate level net trade must close the gap difference between domestic production and consumption, taxes applied to either domestic production, consumption or both

[20] It is worth noting that para. 9 of Annex B of the July Framework Agreement states that "the least developed country participants shall not be required to apply the formula nor participate in the sectoral approach."

[21] The other principal cause referred to in the IMF study is the impact of trade reform on the distribution of real income.

[22] As a share of total tax revenue.

would have the advantage of being relatively broadly based as compared to trade taxes. It is therefore theoretically, possible to switch from trade taxes towards consumption or income taxes in such a way that domestic production, consumption and trade are less distorted, the allocation of resources and welfare are improved and revenue unchanged or even increased (see *e.g.* Keen and Lighthart, 2001).

51. This has formed the basis for the policy advice by the IMF and the World Bank that have, for some time now, been advocating and supporting a move towards more broadly-based tax systems in developing countries (see WTO, 2003d). The communication from the IMF (WTO, 2003a**)** prepared as a result of consultations between the WTO and the IMF argued that "there is in principle no great difficulty in devising a policy mix that replaces tariffs by indirect taxes in such a way as to preserve the revenue without jeopardising other economic and social objectives". The same communication also points to the fact that many countries already have functioning VAT systems in place and these countries are best placed to replace import duties with VAT revenues. Nevertheless, even in these cases the existing systems may need strengthening to ensure effective collection at higher rates.

52. As far as a shift away from trade to other forms of taxation is concerned, indirect taxes are generally preferred to direct forms of taxation. Indirect taxes, which shift the overall taxation burden from factors of production (labour and capital) to consumption, are believed to be associated with superior employment, saving[23] and investment incentives thereby positively affecting the economic development prospects. Indirect taxes are also perceived as more effective in correcting market failures such as for example environmental degradation. In many countries, such taxes can be changed more easily than direct taxes and thus are considered as a more flexible way of raising revenue. Finally, indirect taxes, which are taxes on spending, are also less costly to collect and administer. An argument against indirect taxation is that it tends to be regressive: a uniform tax rate collected on consumption of a particular good discriminates against those with lower income who spend a higher proportion of their income on their tax obligation. Direct taxes tend to be expressed as a percentage of income with progressive bands so that the proportion of the income paid on taxes increases with income.

53. An important objective associated with designing and implementing a revenue replacement strategy is that it does not overturn the benefits associated with tariff liberalisation. Multilateral tariff negotiations are concerned about customs duties – taxes that are levied on imports but not on domestic production - that give domestic producers a price advantage. Other taxes such as sales taxes, excise or VAT taxes should in principle apply equally to domestically produced and imported products. The recommended practice is the equalisation of burdens associated with the sales/VAT tax across imports and domestic production so as to transfer any remaining protection function to the customs duty. Some rule of thumbs with respect to the VAT include a uniform rate applied equally to domestic production and imports across all products but exempting agriculture (to minimise the impact on the poor),[24] a zero rate on exports (Rajarm, 1992) and an appropriate definition of the tax base with minimized incidence of exemptions.

54. Under VAT systems in operation in OECD countries importers are entitled to deduct the tax incurred at the importation from the tax they charge to their customers in the same way they deduct the tax on goods bought on the domestic market. Hence, even if the tax rate on imported goods was higher, goods would still be tax-free in the hands of any business which implies neutrality between imported and domestically produced goods. Discriminatory VAT taxation of imported products can arise if the importer is not entitled to recover VAT or if the higher rate on imports was sustained through the supply chain all the way down to the final consumer. The latter situation would breach a fundamental principle of VAT in addition to being in conflict with WTO rules. The cross-country assessment of the extent of protectionism

[23] One way of avoiding consumption taxes is reducing consumption.

[24] Rajarm (1992) indicates non-marketed food consumed by the poor as a category that is particularly relevant here.

built into the domestic tax system is problematic due to lack of comparable data on burdens of taxation associated with import duties and domestic taxes. This information will nevertheless be critical for countries to ensure that the reformed consumption tax system observes the principle of neutrality.

55. Another aspect that plays an important role in designing and implementing a tax replacement policy is the relative costliness of various forms of taxation. These costs and the relation between them are likely to vary with countries' characteristics. It has been often claimed that in countries at lower stages of development, the administrative costs of raising revenue through trade taxes are low relative to other forms of taxation. This argument may have some validity but what should matter is the overall costliness of the particular form of taxation including efficiency, compliance and administration costs. While compliance and administration costs of import duties that are collected at the border may be lower relative to other forms of taxation, as argued above, the efficiency costs may be quite high making the overall cost of import duties also relatively high. Furthermore, significant shares of other indirect taxes (e.g. VAT) are also collected at the border and enjoy the same advantage of being able to detain the goods at customs and release them only on payment of the tax. This may be preferable to relying on accounting systems of domestic traders especially in countries with high incidence of unreported activity and with underdeveloped tax administrations.

The empirical evidence

56. Notwithstanding the theoretical argument for a simultaneous tariff and tax system reform, there exist a considerable controversy with respect to the feasibility of such a strategy in developing countries whose ability to replace tariffs with indirect taxes has been questioned on structural and political-economy grounds (see *e.g.* Tanzi and Zee, 2001; Khattry and Rao, 2002; Moutos, 2001 and discussions above). Indeed, while to a large extent the causality in Figure 1 may be running from the extensive use of import duties towards the level of development, it has been repeatedly suggested that the level of development itself also determines the ability of countries to implement broadly-based tax regimes.

57. Whalley (2002), for example, reminds us that historically, trade taxes used to be an important source of government revenue in the now high-income countries. Khattry and Rao (2002) and Tanzi and Zee (2000) argue that reliance on tariff revenues will be higher in agricultural economies where the income bases are difficult to assess and tax enforcement is more difficult. Low urbanisation increases the need for taxation (demand for public services) but at the same time reduces the capacity to tax. Inefficient, under-funded and corrupt tax administrations may not be able to assess and collect broad based tax liabilities while trade taxes are relatively easy to assess through monitoring of entry and exit of goods. Large informal sector activities and occupations, domination of small establishments, small share of wages in total national income, small shares of total consumer spending made in large modern establishments all reduce the possibility of relying on certain modern taxes such as personal income taxes or, to a much lesser extent, value added taxes (Tanzi and Zee (2000)).

58. Assessing the extent to which countries that have implemented significant tariff reforms while simultaneously trying to replace the forgone tariff revenue with other taxes is a difficult task. First, the quality of government finance data in developing countries signalled in Box 3 is a serious concern. Second, analysing the simple trends of trade tax and non-trade tax revenues may be misleading. This may be especially the case if, for example, the trade and non-trade tax receipts depend on income (and other macroeconomic variables) in distinct ways. Kahttry and Rao (1998) for example make an observation that a move away from trade taxes in low income countries has been revenue reducing. This conclusion is, however, based on simple correlations without conditioning the observed changes on relevant macroeconomic variables growth and as such has been subsequently questioned in the literature.

59. Keen and Baunsgaard (2004) attempted to correct this shortcoming by econometrically investigating whether in practice countries have been able to recover the losses from trade taxes with revenues from other sources conditioning the relationship between the share of trade and non-trade tax revenue on a number of macroeconomic indicators. The trends observed in the data during the period 1975-2000 indicate the following:

- In the low income country-group a reduction in trade tax revenues (as percent of GDP) has been accompanied by a trend reduction in total tax revenues (as percent of GDP).
- In the middle-income country group, the share in GDP of trade tax revenue has decreased modestly while the total tax revenues (as a share of GDP) have slightly increased.
- In high-income economies, where the share of trade taxes in GDP was already very low at the beginning of the period, the reduction in trade tax revenues coincided with a sustained increase in total tax revenues.

60. In order to econometrically verify these apparent correlations, Keen and Baunsgaard (2004) used a panel of 125 countries over the period 1975-2000 to investigate the relationship between trade and non-trade taxes while controlling for GDP per capita, openness, inflation, aid, the share of agriculture in GDP and the presence of VAT. Their results for the full sample of countries suggest that in the past, on average around one fourth of the trade revenue loss has been offset by increases in other sources of tax revenue. However, the ratio of recovered revenue is not significantly different from zero in low-income countries meaning that these countries have not been able to replace the foregone trade tax revenue. In middle income countries from 45 to 65% of the lost revenue has been replaced by other tax revenues. In high-income countries, any loss in trade revenue has been more than offset with revenues from other sources. Estimations also suggest that there is no systematic evidence that having a VAT has a positive impact on the capacity to replace the forgone trade tax with other tax revenues.

61. Adam *et al.* (2001) investigated the relationship between tax revenue, exchange rate and openness in Sub-Saharan Africa employing dynamic panel techniques. They find that openness raises overall tax revenue in CFA franc[25] countries while it has little effect in non-CFA franc countries. The positive effect is mainly driven by increased trade tax revenues while goods and services tax revenues are actually lowered.

62. Agbeyegbe *et al.* (2004) provide further econometric evidence on the relationship between trade liberalisation, exchange rates and various types of tax revenues for a panel of 22 countries in Sub-Saharan Africa in 1980-1996. They distinguish between international trade taxes, taxes on goods and services and taxes on income, profits and capital gains. They find that the relationship between trade liberalisation and tax revenue is sensitive to whether trade liberalisation is measured by openness or the effective tariff on imports. Furthermore, results are characterised by a strong overall persistence of all components of revenues. Some evidence is found that trade liberalisation has a positive effect on income tax revenue but otherwise is not strongly linked to total tax revenue or its components. Based on their empirical investigation, Agbeyegbe *et al.* (2004) conclude that trade liberalisation accompanied by an appropriate monetary and exchange rate policy does not have a significant effect on overall tax revenue though it may have some (positive) effect on income tax revenue.

63. Additional insights into the past experiences with co-ordinating tariff and tax reforms may be gained from specific country experiences. A recent example includes the OECD study of accession of Kyrgyzstan to the WTO where WTO commitments contained several elements directly affecting government revenue including lowering of many import tariff rates, transition to VAT destination principle and equalisation of import and domestic tax rates [see Box 4 or TD/TC/WP(2004)20 for more details]. The

[25] The currency used by a group of countries in West and Central Africa.

OECD study emphasises that the case of Kyrgyzstan is interesting because the country's commitments had a positive impact on government revenues. Both the shift to the VAT-destination principle and equalisation of excise rates had positive effects on budget revenues. Although exchange rate devaluation had a negative effect on government revenues, overall revenues from foreign trade have considerably increased and now provide more than half of all tax collections in the country. As a result the loss of tariff revenue has been more than compensated by increased VAT revenues on imports and that taxes from international trade have actually increased and now provide more than half of all tax collections in the country [TD/TC/WP(2004)20].

Box 4. WTO Accession of Kyrgyzstan and Changes in Government Budget Revenues

The WTO commitments contained several elements directly affecting government budget revenues, in particular:

- Transition to VAT destination principle in trade with all countries;
- Equalisation of import and domestic excise rates;
- Lowering of many import tariff rates with simultaneous increase of tariffs for a limited number of commodities.

Implementation of these commitments has influenced government revenues in different ways (see Box Table 1). Transition to the VAT destination principle was completed only in 2001, as it took time to coordinate this process with Russia and some other CIS countries. It had a very positive impact on budget revenues, because having origin – rather than destination-based VAT in conditions of negative balance in trade with all important CIS partners led to losses in the government budget. Now the situation has considerably improved, and VAT on imports represents the largest tax item among all taxes in Kyrgyzstan.

Equalisation of excise rates also had positive effects for budget revenues: the average annual collections in real terms increased in 1999-2002 by 43% in comparison to the 1996-1998 annual average, and the share of this tax in GDP has also increased. This means that better reporting and administration of this tax more than compensated for some reduction in import excise rates. However, changes in import tariffs had caused a certain decline in tax collection: those rates that were increased play a protective rather than fiscal role, while lowering of other rates was not offset by proportional increases in import volumes, largely because of general contraction in imports due to exchange rate devaluation.

However, a key conclusion in this area is that, altogether, government budget revenues from foreign trade have considerably increased and now provide more than half of all tax collections in the country.

Box Table 1. Trade-related Tax Collections

	1996	1997	1998	1999	2000	2001	2002
Collections in real terms[26], USD million (2002 prices and exchange rate)							
Total of three types of taxes	**23.7**	**44.5**	**69.6**	**60.6**	**57.9**	**79.6**	**89.7**
VAT on imports	7.5	26.0	41.2	34.0	40.6	62.4	69.5
Import excises	5.7	7.6	12.9	17.5	10.9	10.6	11.3
Import duties	10.4	10.9	15.5	9.1	6.4	6.6	8.9
In % to GDP							
Total of three types of taxes	**1.9**	**3.3**	**5.0**	**4.2**	**3.8**	**5.0**	**5.6**
VAT on imports	0.6	1.9	2.9	2.4	2.7	3.9	4.3
Import excises	0.5	0.6	0.9	1.2	0.7	0.7	0.7
Import duties	0.8	0.8	1.1	0.6	0.4	0.4	0.6
In % to imports							
Total of three types of taxes	**4.1**	**8.1**	**9.7**	**8.7**	**9.4**	**16.2**	**15.3**
VAT on imports	1.3	4.7	5.8	4.9	6.6	12.7	11.9
Import excises	1.0	1.4	1.8	2.5	1.8	2.2	1.9
Import duties	1.8	2.0	2.2	1.3	1.0	1.3	1.5

Source: National Statistical Committee of the Kyrgyz Republic

Source: The role of multilateral and regional trade disciplines: Experience of the Kyrgyz republic, OECD 2004 [TD/TC/WP(2004)20].

[26] Deflated by GDP deflator.

64. Several other examples of trade related fiscal adjustment with both negative and positive impacts can be found in the literature. Abed (1998), for example, reported on the uneven progress in the tariff and tax reforms undertaken since the mid-1980s by some Southern Mediterranean countries. He reviewed comparative data on tax revenue shares over time and concluded that countries that followed the good practice in their tax reforms generally succeeded in reducing their reliance on the taxation of international trade (*i.e.* Egypt, Jordan, Morocco and Tunisia). Several other countries in this region, however, recorded very slow progress in implementing a broad-based consumption tax system. Rajarm (1992) presented a factual review of the extent to which trade policy and tax policy concerns were integrated in the World Bank recommendations during the 1980s. He concluded that the evidence on whether tariff reform proposals anticipated revenue effects and whether the adjustment policies put in place actually helped had been mixed. He also pointed out that there was scope for improving the quality of policy advice through a more explicit consideration of revenue concerns. More recent, positive evidence includes for example Cambodia which reduced and simplified its tariff structure in 2001 when high rates were reduced from 120 to 35% and the number of tariff rate bands was reduced from 12 to 4. To mitigate the impact on government revenue excise duties were raised on excisable products. In this way the revenues could be maintained while at the same time reducing the level of protection (Diagnostic Trade Integration Study, Cambodian Ministry of Commerce, 2001).

Policy coherence

65. Overall, the literature points to both successful and failed attempts at co-ordinating tariff and domestic tax reforms. However, neither the past successes should be regarded as a proof that the replacement of tariff revenues is unproblematic, nor the failures be taken as a confirmation that such reforms are impossible. Evidence is clearly mixed and this calls for a forward looking approach to addressing the adjustment costs that may be associated with tariff cuts agreed in the DDA negotiations. Such an approach should involve both an advance analytical assessment of which countries may be particularly vulnerable as well as an integration of revenue concerns into SDT provisions be it in the form of extended implementation periods or coordinated financial assistance provided to disadvantaged developing countries to help them overcome financial, technical or capacity constraints associated with a tariff-cum-tax reform.

66. As far as the positive dimension of the SDT is concerned, the costs associated with the design and implementation of appropriate tax reforms are temporary while the gains they induce through an improved allocation of resources are permanent. Therefore, from an economic point of view, these costs are seen not as an obstacle to liberalisation but rather a necessary investment to enable the realisation of long term gains. As pointed out by the World Bank "many countries will not be able to take advantage of new opportunities arising out of the Doha Agenda unless the international community helps with technical assistance and capacity building, with policy advice and - importantly - much needed finance to put in place the infrastructure, transport logistics, and trade-related public institutions necessary to take advantage of those opportunities"[27]. In this context, Paragraph 27 of the draft Cancun Ministerial (24 August 2003) welcomed the support from the Executive Heads of the IMF and the World Bank where the two institutions have expressed their commitment to work with the WTO to address problems that some developing countries may have in adjusting to trade liberalisation agreed in the Doha round.

V. Quantification of the revenue effects of tariff reduction

67. The reminder of the paper presents a quantitative examination of the impact on developing countries' government revenue, trade flows and welfare following changes in their bound tariffs. It

[27] Shengman Zhang, Managing Director, of the World Bank, Address to the WTO General Council Plenary Session, 10 September 2003.

discusses simple and complex methodological approaches that can be used to evaluate welfare and revenue impacts of tariff reduction and, focusing on the Swiss tariff reduction formula, applies them to a sample of 24 developing countries. Based on the simulation results, the paper offers a discussion of cross-country differences and provides sensitivity analysis by changing the Swiss formula coefficient. For the sake of comparison, the results obtained using a linear tariff reduction formula are also presented and discussed. Finally, following the discussion of tax reform policies presented above, the paper offers a simulation of the welfare effects of reducing tariffs and simultaneously replacing lost tariff revenues with revenues from consumption tax.

68. The revenue, trade and welfare effects of a tariff reform may be estimated in a variety of ways. Simplest is to take trade in a recent base period as given and apply to it both existing and prospective tariff rates to estimate current and prospective revenues. However, this methodology is subject to the limitation that changes in tariffs are likely to induce changes in the volumes traded and that by ignoring these one would bias the estimates of the revenue effects. In principle, as far as across-the-board tariff cut is concerned, this methodology would result in an overestimation of the revenue effect since it would assume no change in the volume of imports. In addition, this approach does not allow an estimation of the effects of the reform on welfare, which is, after all, the ultimate objective of economic policy. Because of these limitations, this approach is not implemented in this paper.

69. The next simplest approach, implemented below, is to allow quantities to change in response to prices (tariffs) by modelling demand curves for imports and recognising that agents will tend to switch between domestic and foreign sources of a particular good if the domestic prices of imports change as a result of tariff changes. It is a considerable improvement over the approach described above, but it still has the distinct disadvantage that it cannot relate changes in tariffs and trade on one good to those on other goods - *i.e*. it is *partial equilibrium*. Where a far-reaching reform is under consideration this can be a major handicap and result in predictions that, for example, imports will increase dramatically without any corresponding increase in exports. Nonetheless, the advantage of this approach is its tractability. Since the trade and revenue effects at a tariff line level are determined by the initial level of tariff, depth of the cut and estimated import demand elasticity, the partial equilibrium approach serves to provide some “rules of thumb” in respect of the trade structure, initial tariff profile and the tariff reduction formula that influence the direction and magnitude of the revenue impact of changes in tariffs. Hence, this approach involves a trade-off between completeness and tractability: we assume away more complex, general equilibrium, effects of trade liberalisation but we are able to link directly the estimated revenue, trade and welfare impacts to the initial conditions as well as to the type of tariff cut formula that we are considering.

70. In another approach that is employed here, the major shortcomings of partial equilibrium modelling are circumvented while still retaining its strength in dealing with imports at a relatively detailed level in a computable general equilbrium model. This approach is more complex but is also more appropriate in many respects. Using detailed information on economic structures of selected economies and economic policy instruments, the model allows for substitution between different sources of a given import (necessary if tariffs on different partners change differently), between imports and domestic supplies and between different goods in production and demand. Equally important is that this approach allows us to take into account the effects of an interaction of a trade policy reform with collection of revenues from other sources. That is, the general equilibrium approach allows us to address the second objective of this study which is to explore consumption tax as a more efficient way of raising tax revenues by implementing tax reforms. Finally, estimates from the partial equilibrium exercise are then compared with those obtained from the general equilibrium model.

71. The aim of this exercise is not to set different modalities for tariff reduction against their revenue implications. Rather, we take certain tariff reduction modalities as given and then analyse how the trade reform affects government revenue collections from trade, trade flows and welfare. The ultimate objective

is to identify the characteristics of developing countries' trade and tariff regimes that determine the magnitude of the revenue impact in view of identifying some of their trade-related adjustment needs, in particular, adjustments to the domestic tax system.

VI. Revenue impact – partial equilibrium estimates

72. In what follows we use the examples of Argentina, Bangladesh, Brazil, Chile, Colombia, India, Indonesia, Malawi, Malaysia, Morocco, Mozambique, Madagascar, Peru, Philippines, Sri Lanka, Tanzania, Thailand, Uganda, Uruguay, Venezuela, Zambia and Zimbabwe in order to illustrate the revenue, trade and welfare implications of tariff reductions. Although the basic modalities for tariff negotiations in the DDA are not yet known, we use the Swiss formula with three different coefficients (5, 10 and 15) as an illustration of the potential impact on government revenue of changes in tariffs. The focus on the Swiss formula in the presentation of our results reflects the commitment to a non-linear formula agreed by the WTO members in the July Framework. Comparison with the linear formula is included for informative purposes. As discussed above, the Swiss formula has a number of desirable features for tariff negotiations including simplicity and effectiveness in reducing tariff peaks. The Swiss formula implies that high tariffs are reduced by a higher percentage than low ones and that all resulting tariffs fall below a certain threshold.[28]

73. Conceptually, the effect of a given tariff reduction on tariff revenue depends on the initial structure of tariffs, the depth of the cut, and on elasticities of import demand and supply that determine the change in import values resulting from liberalisation[29] (see the derivation of equation 7 in the Technical Annex). Hence, the overall effect of a tariff change will depend on country's initial conditions, which are given, and the modality according to which tariffs are cut agreed in the negotiations.

74. Results from all applied partial and general equilibrium models used for the trade policy analysis depend crucially on trade elasticities – they often drive not only quantitative but also qualitative results (McDaniel and Balistreri, 2002). The revenue impact of a given tariff reduction will crucially depend, first, on how is the bilateral trade modelled and, second, on the values of the estimated trade elasticities. The elasticities of import demand vary over the entire range of products. Although it is difficult to generalise, the existing estimates suggest that demand tends to be relatively inelastic for intermediate goods and raw materials including non-processed agro-food products or primary commodities and relatively elastic for final consumption goods including manufacturing products. Annex Table 3 presents average import demand elasticities for the 2 digit HS classification. These averages are based on elasticities available at 6 digit HS level in the World Integrated Trade Solution (WITS) database. It can be observed that low elasticities are assumed for *e.g.* live animals, vegetable products or minerals while products such as furniture, aircraft or textiles and footwear are relatively price elastic.

75. Moreover, it has to be pointed out that the import demand elasticity of a certain product in a given country depends on many factors, including the availability of domestic substitutes and market structures. Hence, inevitably, in reality import demand elasticities are to a certain extent country-specific and may also reflect comparative advantages of particular countries. Nevertheless, reflecting difficulties with their econometric estimation, the elasticities used in applied trade analysis are typically assumed to vary by sector but not across countries. In fact, the literature is particularly scarce on whether country–specific characteristics or the composition of trade affect the degree of substitutability (McDaniel and Balistreri, 2002). By necessity, and following the main stream of existing literature, the partial and general equilibrium estimates in this study are also based on the assumption that elasticities vary by product but not by country. Hence, the country specificity in terms in responsiveness of trade volumes to trade prices is

[28] A coefficient of 15, for example, implies that all resulting tariff rates fall below the 15 per cent threshold.

[29] We assume an infinitely elastic import supply under a simplifying supposition of limited impact on world.

captured solely by countries' composition of imports (*e.g.* a given country's imports being concentrated in high or low import demand elasticity products).

76. Table 1 below presents summary information on the tariff regimes in our sample based on the Trade Analysis Information System (TRAINS) data at the 6-digit Harmonised System (HS) nomenclature obtained from WITS and Word Development Indicators database. The sample represents a wide spectrum of tariff profiles. The simple average tariff rate level ranges from 5.7% in the Philippines to 32% in India. As far as trade weighted applied rates are concerned, the range is from 3.2% in the Philippines to 27.1% in Morocco. Cross-country differences in simple average bound rates are even more pronounced ranging from 10% in China or 14.5% in Malaysia to 120% in Tanzania or 162% in Bangladesh. It has to be stressed that summary statistics referring to bound rates have to be treated with caution since the extent of bindings coverage varies from country to country. For instance the very high simple average bound rate in Bangladesh is based on bindings that are available for only 15% of the total number of tariff lines.[30]

77. Differences between simple and trade weighed averages are quite substantial for some countries which also in part reflects the fact that trade flows on some of the bound lines are either small or missing. Coefficients of variation reported in the table are ratios of standard deviation of tariff rates to their average and give an indication by how much rates deviate from the average. Hence, a coefficient of variation of 0.5 indicates a 50% standard deviation from the average. As far as this measure of dispersion is concerned, we note that bound duties tend to be more uniform than applied ones. This is not unexpected since bound rates are either a result of the Uruguay Round commitments or accession negotiations to the WTO and as such are not subject to discretionary changes to the extent applied rates tend to be.

78. We also note that the average trade-weighed import demand elasticity is characterised by considerably smaller cross-country variation than tariff averages (see the last line in Table 1). In general, this means that as far as responsiveness to tariff changes is concerned, countries included in the sample turn out to be rather homogenous at given product-level import demand elasticities. Country trade-weighted import demand elasticities in our sample deviate on average by 10% from the mean while average applied tariffs deviate by as much as 50% and bound rates by 70-80%. This observation leads us to expect that cross-country differences in the trade, welfare and revenue effects of a given tariff reduction scenario will be to a large extent driven by differences in tariff levels and not by differences in trade structures. This seems to be a convenient feature from the point of view of analysis of tariff revenue impacts in the context of multilateral tariff negotiations since the revenue effects are less likely to depend on country-specific characteristics such as a tendency to import price elastic or inelastic commodities and more likely to depend on the initial level of tariffs and differences between the bound and the applied rates.

79. In addition, Table 1 presents two indicators of reliance on trade taxes as a source of government revenue.[31] The share of import duties in total tax revenue underlines the importance of import tariffs in a country's tax collection. The second indicator describes the share of taxes on international trade, including import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes in current revenue.[32] Overall reliance on import duties as a source of tax revenue differs considerably from below 5% in Argentina, Brazil, Uruguay and Indonesia to 24% in India , 30% in Bangladesh and 50% in Uganda.

[30] Lines with empty entries are excluded from calculation.

[31] Additional information, including on other developing countries, is provided in the Annex Table 1.

[32] Current revenue includes: all revenue from taxes; non-repayable receipts from the sale of land, intangible assets, government stocks, or fixed capital assets, or from capital transfers from nongovernmental sources; fines; fees; recoveries; inheritance taxes; and nonrecurrent levies on capital.

Table 1. Summary statistics of tariff profiles and dependence on import duties

	Import duties (% of tax revenue)[a]	Taxes on international trade (% of current revenue)[b]	Tariffs						Trade weighed import demand elasticity
			Simple average		Trade weighed average		Coefficient of variation		
Country			applied	Bound	applied	bound	applied	bound	
Argentina	*4.5*	*4.3*	*13.8*	*31.9*	*12.4*	*30.8*	*0.4*	*0.2*	*2.0*
Bangladesh[1]	*30.0*	*22.6*	*20.7*	*162.2*	*21.1*	*20.6*	*0.6*	*0.4*	*1.6*
Brazil	*3.5*	*2.9*	*13.8*	*31.4*	*10.0*	*30.7*	*0.4*	*0.2*	*1.8*
Chile	-	*5.3*	*7.0*	*25.1*	*7.0*	*25.1*	*0.0*	*0.0*	*2.0*
China	*6.6*	*9.5*	*15.9*	*10.0*	*14.1*	*5.9*	*0.7*	*0.7*	*1.9*
Colombia	*8.5*	*7.3*	*12.3*	*42.8*	*11.3*	*45.3*	*0.5*	*0.5*	*2.2*
India	*24.1*	*18.5*	*32.0*	*49.3*	*26.4*	*28.2*	*0.4*	*0.8*	*1.8*
Indonesia	*4.6*	*3.1*	*6.9*	*37.5*	*4.3*	*37.2*	*1.5*	*0.3*	*1.6*
Madagascar[1]	*53.5*	*51.9*	4.6	27.4	3.2	8.7	*1.1*	*0.2*	*1.8*
Malawi[12]	-	-	*13.1*	*75.3*	*12.4*	*26.7*	*0.7*	*0.5*	*2.0*
Malaysia	*13.3*	-	*8.3*	*14.5*	*4.8*	*5.8*	*1.3*	*0.8*	*1.6*
Morocco	*18.8*	*15.9*	*30.6*	*41.2*	*27.1*	*43.8*	*0.8*	*0.5*	*2.0*
Mozambique[1]	-	-	*12.1*	*99.7*	*9.1*	*99.8*	*0.8*	*0.1*	*1.7*
Peru	*10.5*	*9.1*	*13.7*	*30.1*	*12.8*	*31.3*	*0.3*	*0.1*	*1.9*
Philippines	*19.6*	*17.2*	*5.7*	*25.6*	*3.2*	*7.8*	*1.1*	*0.5*	*1.7*
Sri Lanka	*12.7*	*11.3*	*9.3*	*29.7*	*6.7*	*10.9*	*0.9*	*0.7*	*1.8*
Tanzania	-	-	*16.3*	*120.0*	*13.1*	*18.0*	*0.5*	*0.0*	*1.8*
Thailand	*12.3*	*10.4*	*16.1*	*25.7*	*9.3*	*9.8*	*0.9*	*0.6*	*1.9*
Uganda[12]	*50.3*	*49.8*	*8.9*	*73.5*	*7.1*	*12.0*	*0.6*	*0.2*	*1.9*
Uruguay	*3.0*	*2.9*	*13.8*	*31.7*	*12.4*	*31.1*	*0.5*	*0.2*	*2.0*
Venezuela	*12.1*	*7.0*	*12.4*	*36.8*	*13.4*	*37.8*	*0.5*	*0.4*	*2.0*
Vietnam	*21.4*	*19.7*	*16.5*	-	*17.5*	-	*1.1*	-	*1.9*
Zambia[12]	-	-	*12.6*	*105.7*	*9.2*	*20.9*	*0.7*	*0.3*	*1.7*
Zimbabwe [2]	*19.0*	-	*19.6*	*92.1*	*10.4*	*7.3*	*0.8*	*0.7*	*1.6*
Cross-country coef. of variation	*0.8*		*0.5*	*0.7*	*0.5*	*0.8*	*0.6*	*0.7*	*0.1*

ab Taxes on international trade include import duties, export duties, profits of export or import monopolies, exchange profits, and exchange taxes. Current revenue includes all revenue from taxes and nonrepayable receipts (other than grants) from the sale of land, intangible assets, government stocks, or fixed capital assets, or from capital transfers from nongovernmental sources. It also includes fines, fees, recoveries, inheritance taxes, and nonrecurrent levies on capital. Data refer to central government only. The reference year is 2001 with exception of Bangladesh, China, Colombia, Morocco (1999), Brazil (1998), Madagascar (2000), Vietnam (2002)

[1]Denotes LDCs and [2] denotes landlocked countries.

Source: WB World Development Indicators based on IMF Government Finance Statistics, GTAP and WITS databases and OECD Secretariat's model simulations using GTAP model.

80. In what follows we present the results of a simulation using the partial equilibrium approach described in the Technical Annex to estimate the trade and revenue effects of a Swiss formula with the coefficients of 5, 10 and 15. For the sake of comparison, we apply each version of the formula directly to applied rates as well as to bound rates. While the first option is interesting in the sense that results can be related more directly to the properties of the analysed formula, the latter option tries to mimic the actual

reality of the WTO negotiations where the base for the cuts has historically been the bound rate and the applied rates are only lowered if the bound rates falls below the initial level of the applied rate. For tariff lines where bindings are not reported we assume the double of the applied rate as the base for tariff reduction.[33] The results of this simulation are presented in Annex Tables 4a-4f.

81. In the description of results we first concentrate on the Swiss formula scenario with a coefficient of 10 in order to investigate cross-country differences in revenue impacts. Next, we compare Swiss formula results for the three different coefficients in view of providing some information on how trade and revenue changes are affected depending on the ambition of the agreed tariff cut.

Cross-country differences: Swiss formula with a coefficient of 10

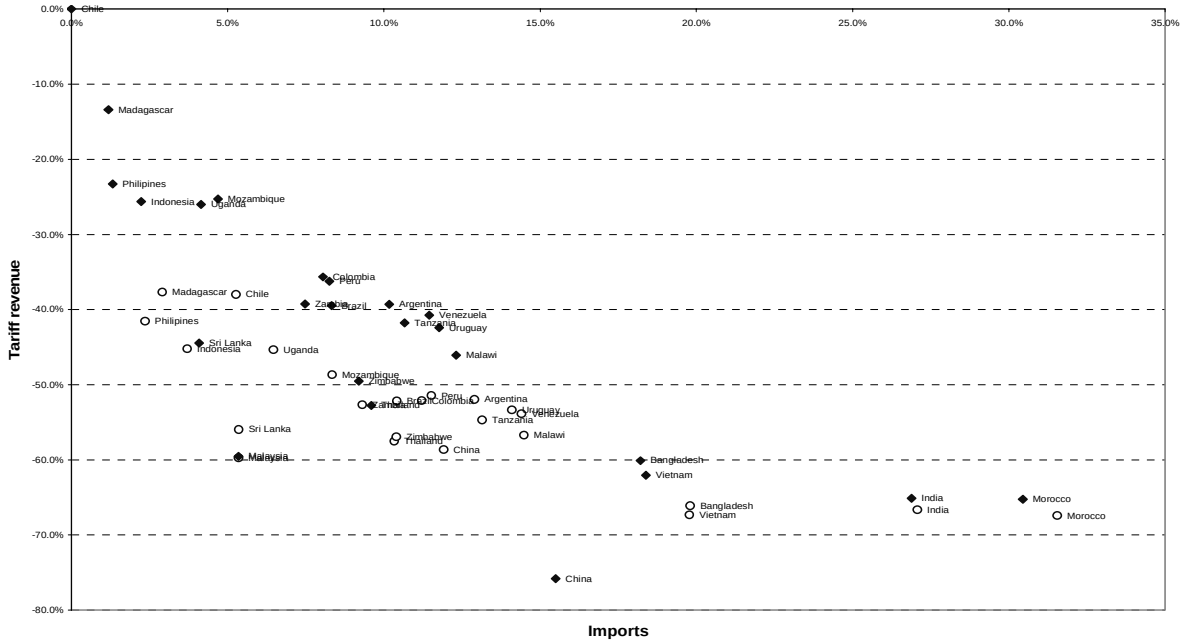
82. The results of tariff reduction according to the Swiss formula with the coefficient of 10 are included in Annex Tables 4d and 4e and presented graphically in Figures 6 and 7 where empty dots indicate the results for Swiss formula using applied rates, and diamonds those where the formula is applied to bound rates. First, the results indicate considerable cross-country differences in trade and revenue impacts.

83. Trade impacts using bound duties are as low as zero on both trade and revenue in Chile where the uniform bound tariff is reduced from 25.1% to 7.1% which actually does not bite into the initial uniform applied rate at 7%. Chile is, however, the only country with a uniform tariff schedule in our sample where the impact on average tariff rate is relatively easily reconcilable with the trade and revenue effects. In other countries tariffs are not uniform and tariff averages are less informative. For example, lowering the simple average bound tariff in the Philippines from 25.6% to 6.1% (which is above the initial average applied rate) does not imply that none of the applied rates is lowered. In fact, on some lines the lowering of bound rates is deep enough to affect some applied rates. As a result, the simple average applied rate is lowered from 5.7% to 4.2% which boosts imports by 1.3% and results in 23.3% reduction in tariff revenue. This is also the case in Madagascar where the tariff regime produces a low initial average applied rate at 4.6% and a relatively high average level of bound rates at 27.4%. In Madagascar a Swiss formula with a coefficient of 10 results in a 1.2% increase in imports volume and a decrease in the tariff revenue by 13%.

84. Among countries where the Swiss formula with a coefficient of 10 substantially affects the profiles of applied tariffs and hence trade volumes and tariff revenue collection, are countries like Morocco, India or Bangladesh which are characterised by initially high applied rates. In these countries, the size of binding overhang does not matter to a great extent since this version of the Swiss formula implies that all bound rates are reduced below 10% which is significantly below the average initial level of applied rates. Here, the trade and revenue effects are close to those that would be observed if the formula was applied directly to applied tariff rates (compare the first four columns on Annex Table 4d). This group of countries experiences significantly larger trade and revenue impacts with India, for example, recording a 27% expansion in trade volume and a 65% loss in tariff revenue.

[33] This is similar to the proposal discussed in WTO (2003b).

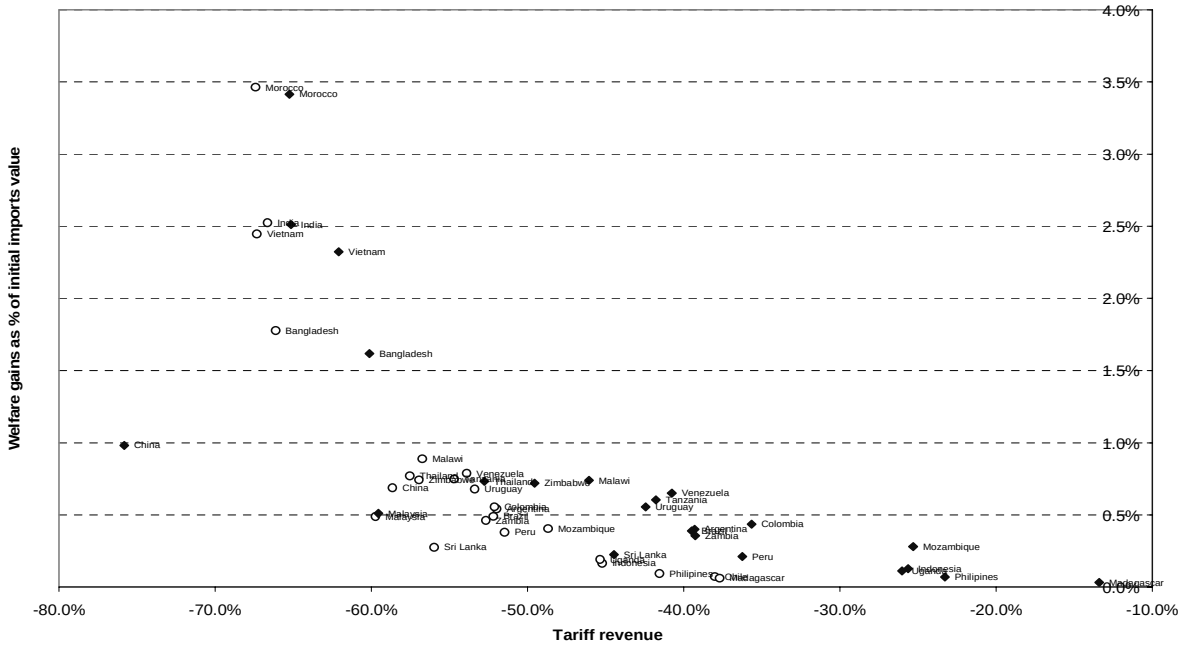
Figure 6. Swiss formula with the coefficient of 10 - comparison of trade and revenue effects



♦ Swiss formula affecting directly applied rates ○Swiss formula affecting bound rates

Source : OECD Secretariat's calculations

Figure 7. Swiss formula with the coefficient of 10 - comparison of welfare and revenue effects



♦ Swiss formula affecting directly applied rates ○Swiss formula affecting bound rates
Source : OECD Secretariat's calculations

85. Overall, the results indicate that there is a strong negative correlation between the trade and the revenue effects: countries that are most affected in terms of revenue also experience the most significant trade creation and welfare gains. There are however exceptions to this rule where two countries that

experience similar expansion of imports may be losing a different share of their tariff revenue. For example, Mozambique and Malaysia's imports increase by comparable proportions (4.69% and 5.35% respectively) but the percentage impact on Malaysia's revenue is considerably higher at approximately 60% as compared to the impact on Mozambique of around 25%.

86. It is therefore interesting to investigate what is the principal factor that drives the differences in trade and revenue impacts across countries? Even in the simple framework considered here the answer to this question is not clear-cut. As discussed above, each country-level revenue effect is the sum of tariff line effects and depends on the tariff profile, import demand elasticities, trade pattern and the depth of the cut which in the case of the Swiss formula itself depends on the initial tariff. Additionally, from an analytical point of view, the final effect is obscured by the fact that the cut is applied to the bound tariff rate. The applied rate is lowered only in circumstances where the bound rate falls below the applied one. Hence, some properties of the assumed formula of tariff cuts, such that high rates are cut by a higher proportion, may not hold as far as the effect on the applied rates is concerned. Overall, many factors play a role and the final effect is essentially an empirical question.

87. Nevertheless, following up on the observation that the average import demand elasticities are relatively uniform across countries in the chosen sample while the initial trade-weighted tariffs vary considerably, we expect that to a large extent the cross country variation in results presented here is explained by the dispersion of the initial tariffs across countries as well as country differences in binding overhangs. In the Technical Annex we show that the linear tariff cut formula implies a positive relationship between the initial rate and the proportional revenue and trade impacts for any import demand elasticity or formula coefficient. We also show that this result cannot be extended to the case of the Swiss formula where depending on import demand elasticity and the initial tariff rate, this relationship may be positive or negative. We have calibrated equations 13 and 14 in the Technical Annex to import demand elasticity of 2 which is approximately equal to the trade weighted elasticity in our sample[34] for the Swiss formula with a coefficient of 10. Such a calibration suggests a negative relationship between the initial tariff and the revenue impact (see Technical Annex Figure 3) where a higher initial tariff rate implies a deeper revenue loss and a larger trade creation effect.[35]

88. In order to investigate whether there is indeed a correlation between the levels of initial applied rates and the revenue and trade impacts we compare country results for the Swiss formula with coefficient of 10. In order to separate out the effects of varying levels of binding overhangs we focus on the scenario where the formula reduces directly applied rates (compare columns 1,3 and 5 in Annex Table 4d). Indonesia and Bangladesh for example are characterised by the same level of trade-weighted import demand elasticity (see Table 1) but experience substantially different trade and revenue effects. Indonesia with the low average trade weighted tariff of 4.3% records a 3.7% increase in imports and a 45% reduction of tariff revenue. Bangladesh with a high average trade-weighted tariff of 21% experiences a 19.8% increase in imports and 66% decrease in tariff revenue. Figures 9 and 10 indicate that this result holds broadly across the entire sample.

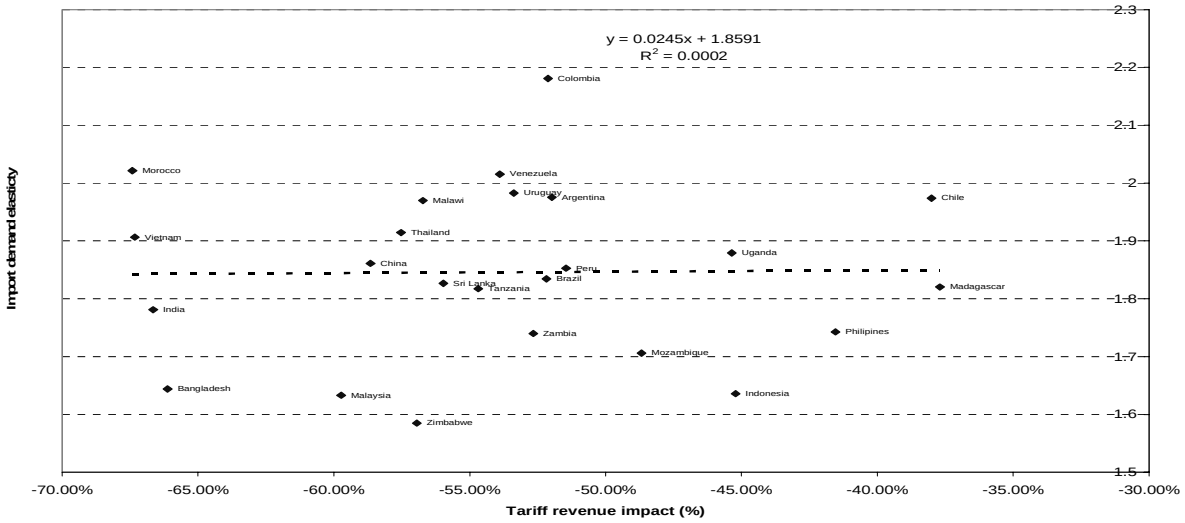
89. In Figure 8 the proportional revenue impact is plotted against the import demand elasticity and in Figure 10 against the initial tariff rate. The correlation of revenue impact with the import demand elasticity is rather weak while the correlation with the initial applied rates appears to be strong. We do not report this result here but these conclusions also hold when the formula is applied to bound rates.[36]

[34] The exact mean is 1.8, the coefficient of variation is 0.1 and the cross country spread is 1.6 – 2.2.

[35] The percentage increase in trade is generally not of the same magnitude as one on revenue.

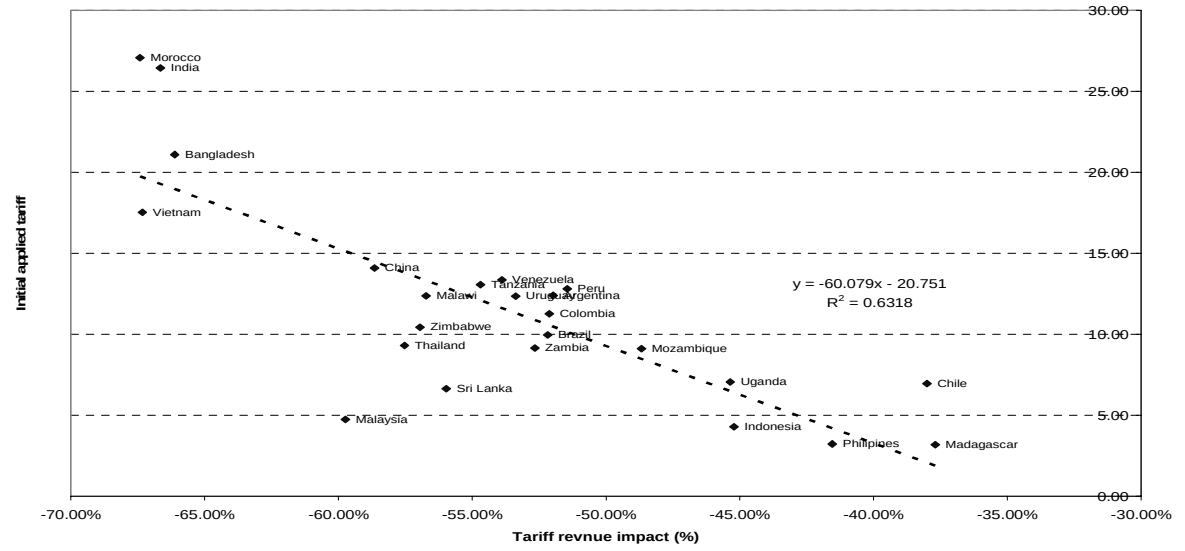
[36] In this case the correlation with the applied rates is a bit weaker which is, however, expected since the results are also affected by the additional sources of cross-country differences *i.e.* differential size of the binding overhang).

Figure 8. Tariff revenue effect by average trade weighted import demand elasticity (Swiss formula 10).



Source : OECD Secretariat's calculations

Figure 9. Tariff revenue impact by initial applied tariff (Swiss formula 10).



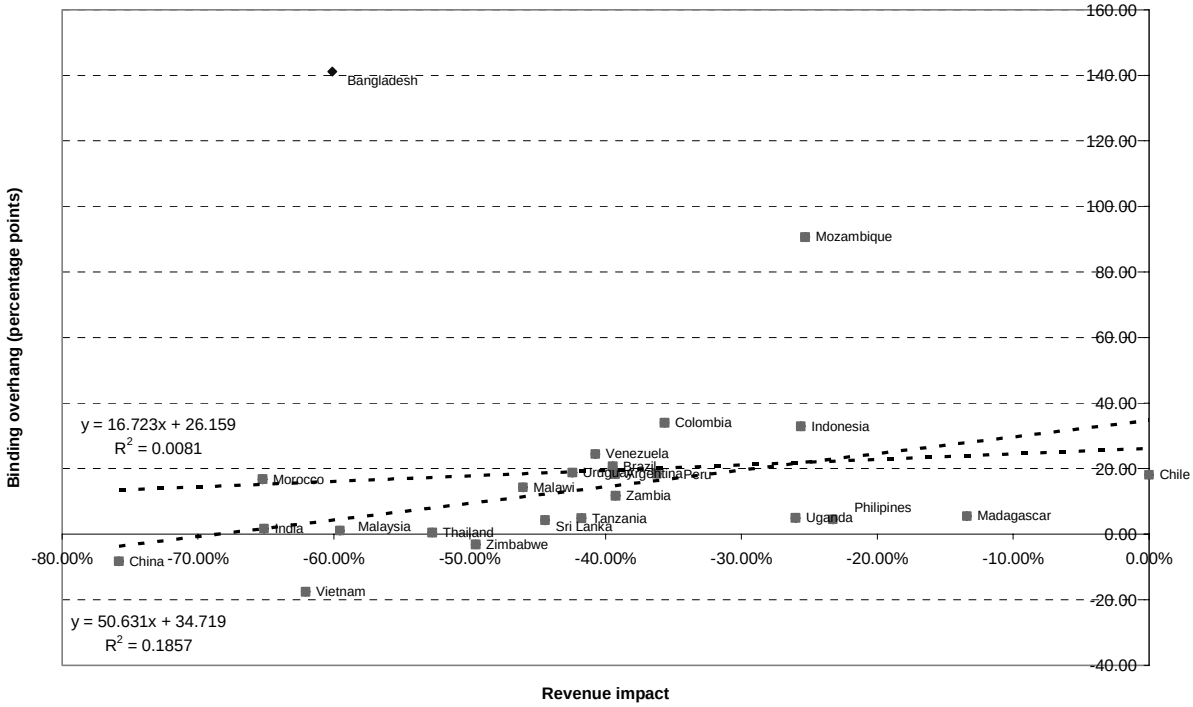
Source : OECD Secretariat's calculations

90. Another important source of cross-country differences are differing levels of binding overhangs. For example, in both Indonesia and Malaysia the initial average trade weighted applied rate is around 4.5 (4.3 and 4.8 respectively) and the average trade-weighted import demand elasticity is 1.6.% However, the two countries have considerably different levels of average bound tariffs at 37.2 and 5.8%, respectively.[37] A tariff reduction according to the Swiss formula with a coefficient of 10 leaves the two countries with considerably different trade and revenue impacts: Indonesia's imports rise by 2.2% and tariff revenue

[37] Simple averages are 37.5% and 14.5% respectively.

contracts by 25.6% while Malaysia's imports rise by 5.4% and tariff revenue contracts by 59.5%. In this case Malaysia, which has a smaller binding overhang, experiences a more extensive tariff revenue reduction but also higher resultant welfare gains. Figure 10 illustrates the correlation of revenue impacts with the initial levels of binding overhang for all countries in the sample. Included for illustrative purposes are linear trend lines for the whole sample and the sample excluding Bangladesh. Bangladesh with the highest difference between the simple average bound and applied rate of 140 percentage points also experiences a large revenue reduction. Exclusion of this country from the sample considerably changes the slope of the line and improves its fit.

Figure 10. Tariff revenue effect by the level of binding overhang (Swiss formula 10).



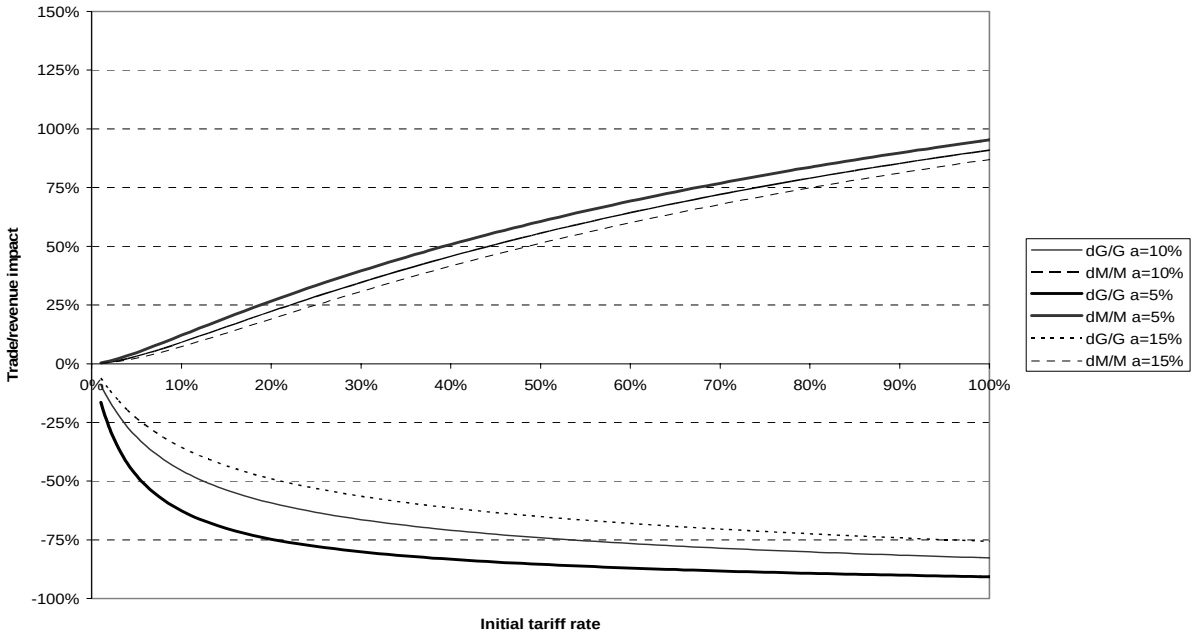
Source : OECD Secretariat's calculations

91. In sum, the results of simulating reductions in tariffs according to the Swiss formula indicate considerable cross-country differences in trade, welfare and revenue impacts. We show that to a large extent these differences are explained by the initial level of applied tariffs and by differences between levels of bound and applied rates (binding overhangs) but not so much by differences in these countries' aggregate responsiveness to trade price changes. In particular, countries with higher initial tariffs and lower binding overhang experience deeper percentage revenue loss but also larger trade creation and welfare gains.

Changing the Swiss formula coefficient

92. In this section, we compare results for three different coefficients of the Swiss formula (*i.e.* 5, 10 and 15) to shed more light on how trade and revenue changes are affected depending on the level of ambition of the agreed tariff cut. The Swiss formula coefficient sets the upper ceiling on the maximum resulting tariff but also affects the proportion by which tariffs are cut. Based on equations 14 and 15 in the Technical Annex, Figure 11 presents the functional relationship between the initial rate and proportional trade and revenue impacts for the three Swiss formula coefficients with an import demand elasticity of 2.

Figure 11. Sensitivity of revenue and trade impacts to the Swiss formula coefficient

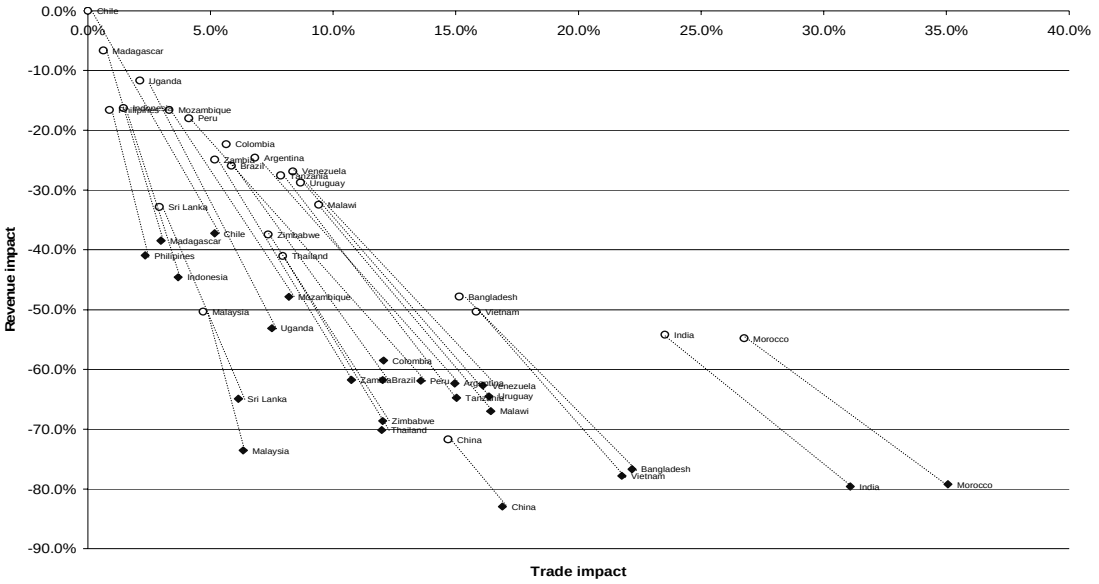


Source : OECD Secretariat's calculations

93. Since import demand elasticities and bound and applied tariff levels differ by tariff line, the actual simulation results are unlikely to be located exactly on the depicted lines. However, Figure 11 provides an indication of how sensitive the trade and revenue impacts are to changes in the Swiss formula coefficient given the assumed framework and the average import demand elasticity of 2. Although comparing the proportional impacts on trade and revenue runs the risk of "comparing apples with oranges" we note that the proportional revenue impacts are more sensitive to changes in the coefficient as compared to trade impacts.

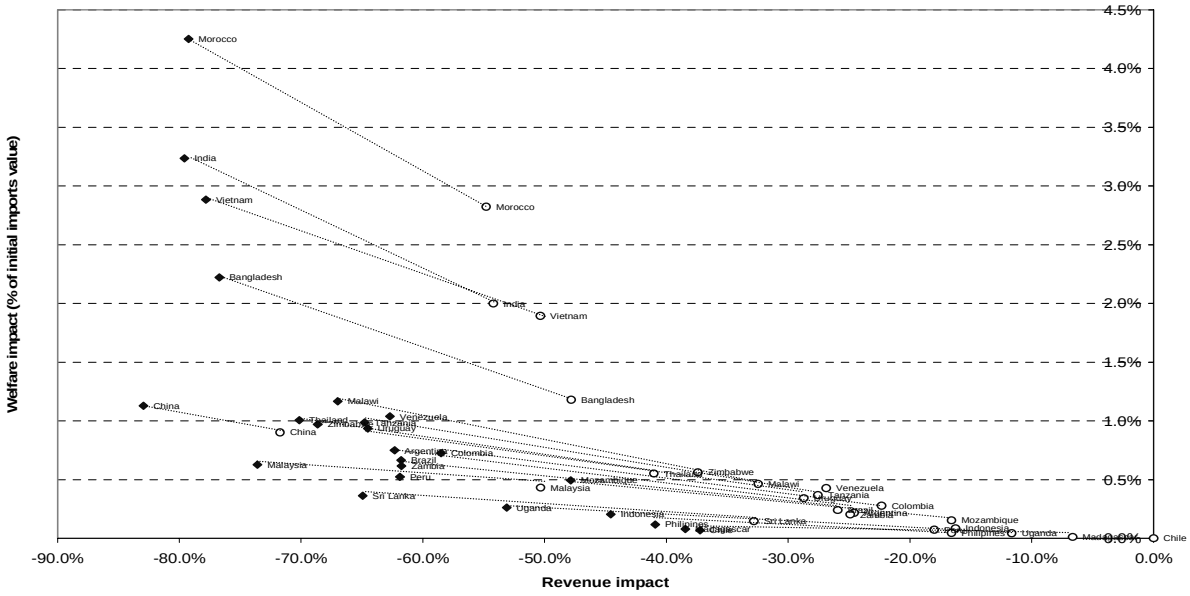
94. Indeed, Figures 12 and 13 below illustrate that for most countries there are substantial differences in percentage impacts on the revenue while the differences in impact on import volumes are smaller. For Uganda for example the difference between the two Swiss formula coefficients translates to 42 percentage points difference in the revenue effect (11% and 53% for coefficients of 5 and 15 respectively) and 5 percentage points difference in trade effects. For the Philippines using a coefficient of 15 would imply an 11% reduction in tariff revenue and a coefficient of 5 would imply a 53% reduction. The respective trade creation effects would be 2 and 7%.

Figure 12. Comparison of trade and revenue effects for Swiss formula with coefficients of 5 and 15



♦ Swiss formula with coefficient of 5 ○ Swiss formula with coefficient of 15
Source : OECD Secretariat's calculations

Figure 13. Comparison of welfare and revenue effects for Swiss formula with coefficients of 5 and 15



♦ Swiss formula with coefficient of 5 ○ Swiss formula with coefficient of 15
Source : OECD Secretariat's calculations

VII. Results of the General Equilibrium Exercise

95. The estimation of changes in tariff revenue presented above is relatively straightforward and requires only limited information such as import structure, tariff regime and import demand elasticities. There are, however, a number of caveats that should be borne in mind. First, and as stated earlier, this approach can only model changes in consumer surplus and tariff revenue and thus is a rather imperfect way

of estimating the effects of the reform on welfare, which is, after all, the ultimate objective of economic policy. Second, the estimated impact on tariff revenue is only an approximation in the sense that we are not able to account for cross-sector, cross-country effects of tariff reforms.

96. In order to correct the shortcomings of the partial equilibrium modelling while still retaining some of its strength of dealing with imports at a fairly detailed level, a general equilibrium approach is used. This approach is more complex but is also more appropriate in many respects. In particular the partial equilibrium approach does not take into account the interactions in the world economy and therefore will generally be less adequate an approach when it comes to simulating multilateral tariffs reduction. Using an economic model with detailed information on bilateral trade and protection levels as well as on interaction in domestic product and factor markets allows us to capture the effects of substitution between different sources of a given import (necessary if tariffs on different partners change differently), between imports and domestic supplies and between different goods in production and demand.

97. In a general equilibrium framework, two kinds of substitution effects affect the change in tariff revenue. The substitution between domestic and foreign products is similar to that analysed in the partial equilibrium framework with the difference that both the world prices and domestic prices change in the process of clearing world markets. Hence, the change in tariff rates is not the sole factor affecting relative prices. In addition, economic agents substitute between imports from different sources if prices of similar product varieties produced in different countries change disproportionately. Another advantage of a general equilibrium analysis is the so called scale effect. Percentage change in total imports is affected by income changes resulting from a trade policy reform. If aggregate income increases, everything else being equal, an expansion in import demand will be observed. Hence, in comparison to the partial equilibrium approach the general equilibrium model allows for more reality in the description of economic relationships.

98. Of course, all estimates presented here are based on a static resource allocation exercise taking resources, technology and institutions as given. If the tariff liberalisation encouraged inflows of technology (as it is expected to do)—say, through increased imports or exports, FDI, licensing etc. - or if it introduced fundamental institutional reform, it would have larger positive effects on welfare and, almost certainly, lower negative effects on revenue. Similarly we do not account for international flows of capital or migration.

99. In the remainder of this section we present estimates of the revenue, trade and welfare changes associated with three Swiss formula scenarios for tariff reduction using a static, perfect competition version of the GTAP model (see Hertel, 1997 for a description of model structure) and the preliminary release of version 6 of the GTAP database. We also compare these results with those obtained using the linear formula for tariff cuts. In order to facilitate the interpretation of the results, countries are aggregated into 36 regional groupings (Annex Table 5) where each of the countries in our sample is a distinct region. Industry categories are aggregated into ten sectors (Annex Table 6).[38]

100. As indicated in the Data Annex, the sources of trade and tariff data used in the general equilibrium exercise differ from those used in the partial equilibrium exercise. The reference year for the GTAP database is 2001 while the TRAINS data used in the partial equilibrium exercise refer to the most recent year in period 2000-2002. Additionally, the tariff rates available in the GTAP database include ad valorem equivalents of specific duties as well as preferential tariff rates from the ITC/CEPII MacMapps database. Hence, the baseline average tariff values may differ between the two approaches (compare Annex Tables 4a and 8). Therefore, the quantitative results obtained from the two approaches may not be directly comparable. Nevertheless, by using the two datasets we gain the advantage of being able to compare the

[38]Aggregation of sectors and geographic areas also permits some reduction of error in the estimates while increasing ease of computation.

two sets of estimates of revenue impacts and discuss similarities and differences. This contributes to the robustness of some conclusions.

101. Similarly to the partial equilibrium simulation, the general equilibrium assessment employs a conditional applied tariff rate procedure. The trade policy changes defined with respect to bound rates are translated into conditional applied rates. For each line, the applied rate is only reduced in the event the tariff binding falls below the initial applied threshold. The resulting applied rates are thus conditioned on the pre-shock level of unused protection (*i.e.* the difference between the bound and applied rates). Annex Table 8 presents average trade weighted applied and bound tariff rates in our sample of countries. Overall, the variation in the size of binding overhangs shown in the Annex Table 8 implies that across-the-board reduction in average bound tariffs will not necessarily lead to a proportional reduction in the corresponding applied rates.

102. The measure of change in welfare is the equivalent variation in income. Equivalent variation in income is the money metric equivalent of the utility change brought about by the price change. At a less abstract level, welfare gains from trade liberalisation can be broken down into two components: (1) the change in efficiency with which countries utilise their resources, and, (2) the change in its terms of trade (Hertel and Martin, 1999). As far as the issue of tariff revenue is concerned, any change in equivalent variation in fact already reflects the welfare valuation of a given tariff revenue loss or gain and as such, with the usual caveats, is the ultimate measure that is used to assess the economic efficiency of any contemplated change in policy.

103. Annex Table 7 provides a summary of global welfare results of a simulation of a multilateral tariff liberalisation according to three different coefficients in the Swiss formula. The global annual, static welfare gains range from USD30 billion in the case of Swiss formula with the coefficient of 15 to approximately USD 44 billion in the case of Swiss formula with the coefficient of 5. Developing country regions capture around 45% of these gains. In terms of the absolute welfare gains the biggest beneficiaries among the 24 developing countries in our sample are China, Argentina, India and Thailand each with annual static welfare gains above US$ 1.8 billion. In terms of percentage welfare increase relative to base, the biggest gainers are Thailand, Vietnam, Malaysia, and Sri Lanka which all experience more than a 1% per capita annual increase in welfare (Annex Table 9).

104. Our simulation also indicates that certain countries such as Chile, Colombia, Tanzania or Uganda may experience welfare losses. In all these cases the negative welfare outcomes are a result of unfavourable terms of trade effects which outweigh the gains from better allocation of resources. The multilateral lowering of tariffs may result in increases in world prices of some traded goods and falls in prices of others. Depending on the composition of their trade, some countries gain from these changes and some loose. In a model with many regions and commodities, understanding the reasons for the observed terms of trade changes can be difficult. Colombia for example experiences a relative reduction in the prices of its exports in all ten sectors with the deepest decrease reaching 2.7% in *Motor vehicles and parts.* The negative welfare outcome in Chile has its source a considerable increase in prices of commodities it imports and particularly of *Primary agriculture* by 4.22%. Tanzania faces a problem similar to Colombia's: prices of its exports fall including large falls in its main export sectors *Primary* and *Processed agriculture* and *Other manufacturing*. In Uganda, too, welfare losses associated with terms of trade changes have their source in falling prices of Uganda's main exports: *Primary* and *Processed agriculture*.

Comparison with partial equilibrium estimates

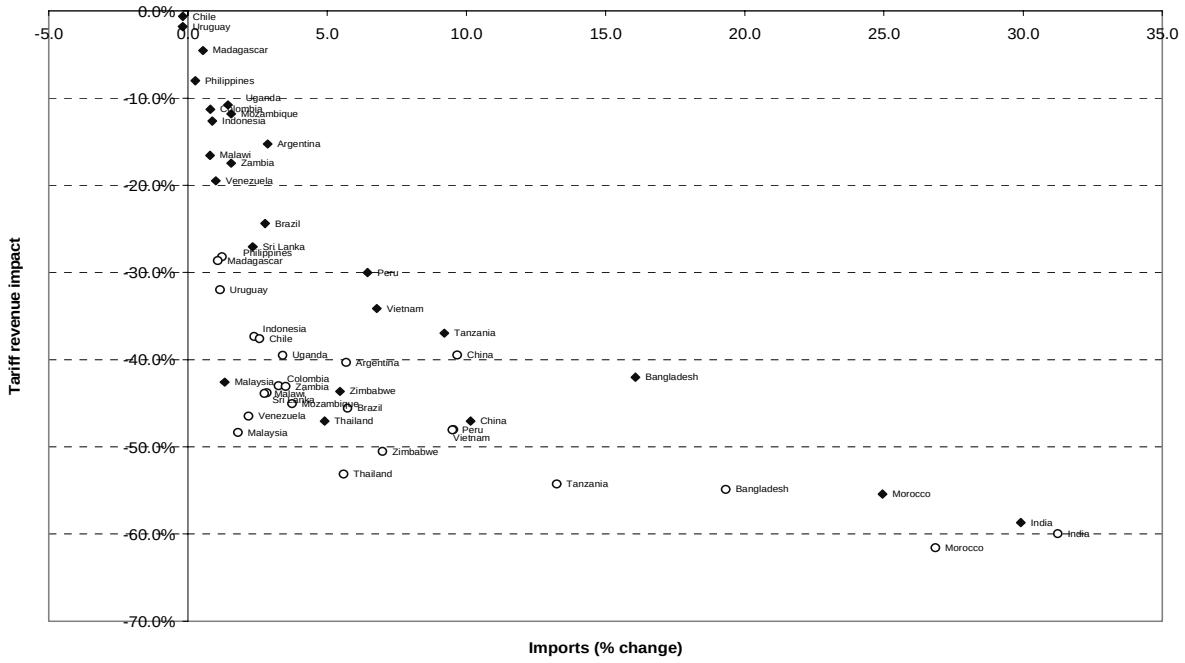
105. It is interesting to compare the estimates from the general equilibrium simulation with those from the partial equilibrium. Annex Table 11 presents the rankings and the numerical estimates of trade, revenue and welfare estimates from the two approaches. We note that the partial equilibrium approach in most

cases yields lower estimates of welfare effects and deeper percentage reductions in tariff revenue. These differences can be explained by the simplified approach to the estimation of welfare changes in the partial equilibrium approach where we are only able to capture the effects on consumer surplus and revenue but not gains associated with increased economic efficiency. As far as the impact on tariff revenue is concerned, the partial equilibrium approach is likely to overestimate the revenue loss since it does not account for other effects such as an increase in income which is likely to mitigate the negative impact on tariff revenue. While the differences in adopted methodologies are likely to be driving most of the differences in the results, one reason may be the different base data. Interestingly, both approaches yield similar rankings of revenue and welfare effects. For example the 7 countries that are most affected by the tariff revenue loss in the partial equilibrium simulation are also the 7 most affected countries in the general equilibrium simulation. Results with respect to welfare changes differ more between the two approaches but there is still a significant overlap in the two rankings (see Annex Table 11).

Cross-country differences: Swiss formula with a coefficient of 10

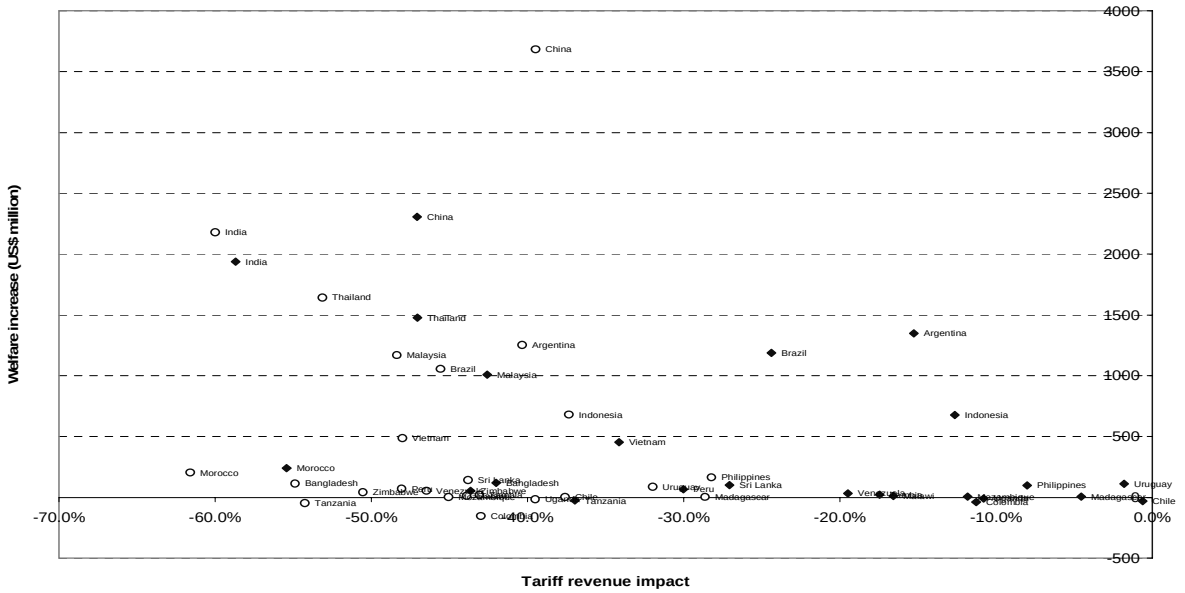
106. Figures 14 and 15 provide a graphical summary of general equilibrium revenue, trade and welfare impacts obtained for the Swiss formula with the coefficient of 10. The empty dots indicate the results for the Swiss formula using applied rates, and diamonds those where the formula is applied to bound rates. We note that, similarly to the partial equilibrium simulation, there is a wide dispersion of revenue impacts ranging from below 10% in Chile, Uruguay, Madagascar, Philippines or Uganda, to above 50% in Morocco or India. There is also a strong negative correlation between the trade and revenue effects *i.e.* countries that are most affected in terms of revenue also experience the most significant trade creation and welfare gains.

Figure 14. General equilibrium simulation trade and revenue impacts of Swiss formula 10 (bound and applied rates)



♦ Swiss formula affecting directly applied rates ○Swiss formula affecting bound rates
Source : GTAP simulations

Figure 15. General equilibrium simulation: welfare and revenue impacts of Swiss formula 10 (bound and applied rates)



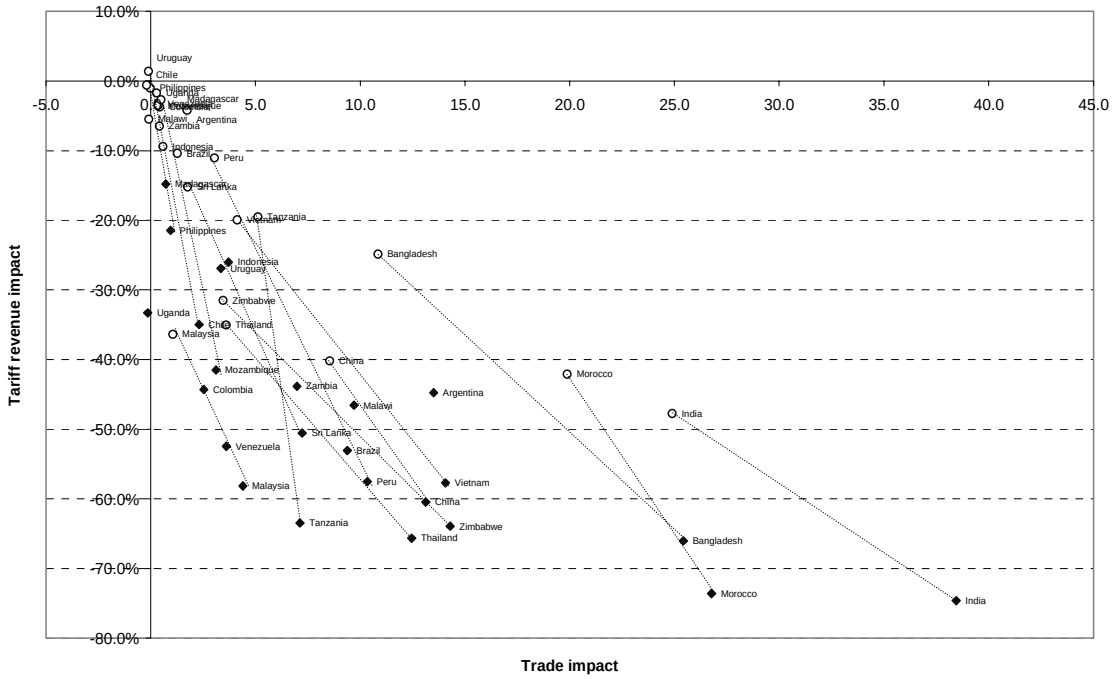
♦ Swiss formula affecting directly applied rates ○Swiss formula affecting bound rates
Source : GTAP simulations

107. Despite the fact that import demand elasticities used in the general equilibrium exercise differ from those in the partial equilibrium exercise (compare Table 1 and Annex Table 8) they yield a similar qualitative observation: the cross country dispersion of average trade weighted elasticity is much lower than the dispersion of initial applied tariff rates or tariff bindings. As a result, the cross country variation in the revenue impacts is driven to a large extent by differences in initial tariff profiles than by differing import structures. This point is illustrated in Annex Figures 3, 4 and 5 where we plot revenue impacts against the trade-weighted import demand elasticity, average trade-weighted initial applied tariff and the level of binding overhang. As in the case of partial equilibrium estimates (Figures 8, 9 and 10) percentage revenue impacts are correlated negatively with the initial level of applied tariffs. This confirms the partial equilibrium result that for the assumed import demand elasticity and initial tariff rates Swiss formula type of tariff reduction is likely to result in deeper percentage revenue reduction in countries with higher initial tariffs.

Changing the Swiss formula coefficient

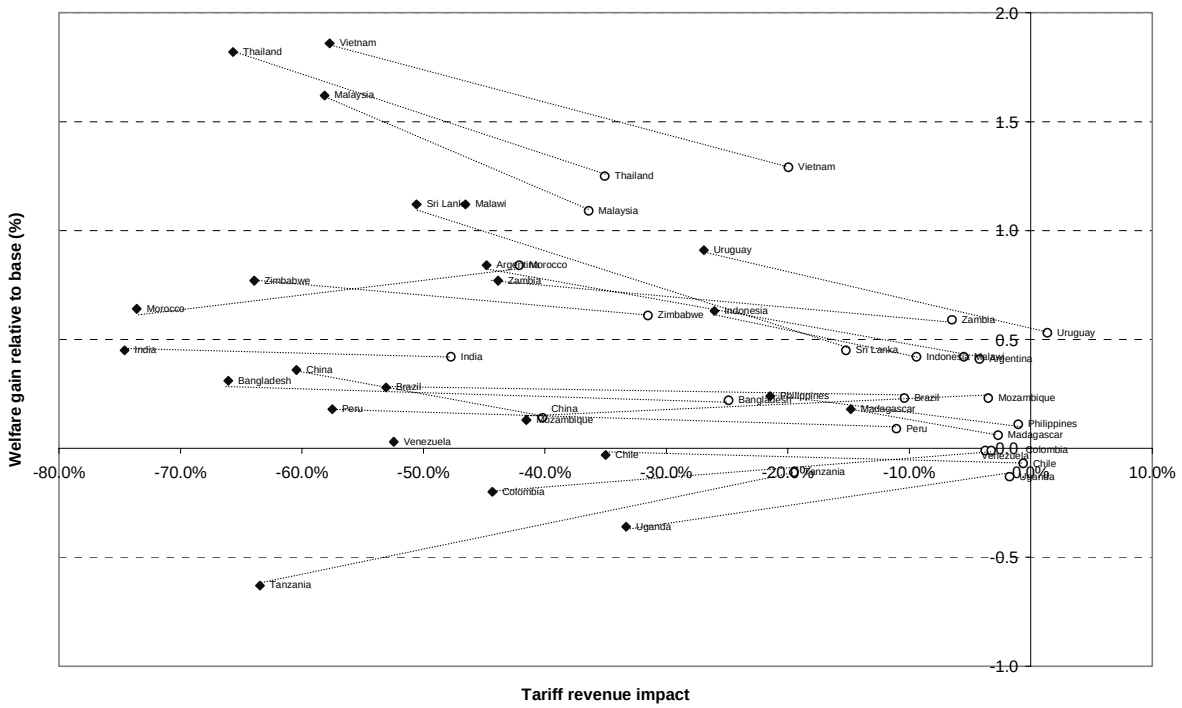
108. Figures 16 and 17 illustrate that for most countries there are substantial differences in percentage impacts on the revenue while the differences in impact on trade creation or welfare are smaller. First we note that for Colombia, Morocco, Mozambique, Tanzania and Uganda a move from the Swiss formula coefficient of 15 to 5 would imply both deeper revenue loss and smaller welfare gain. For all the other countries a more ambitious tariff cut brings higher welfare gains but may also result in higher percentage of forgone revenue. For some countries additional welfare gains associated with a more ambitious Swiss formula coefficient are more "expensive" in the sense that they lose a high percentage of revenue but gain a relatively small percentage of additional welfare gain. Such is the case of Bangladesh, Peru or Brazil. For Bangladesh, for example, an additional 0.09 percentage points of welfare may "cost" as much as 41 percentage points of foregone tariff revenue.

Figure 16. General equilibrium simulation: trade and revenue impacts for Swiss formula 5 and 15



♦ Swiss formula with coefficient of 5 ○ Swiss formula with coefficient of 15
Source : GTAP simulation

Figure 17. General equilibrium simulation: welfare and revenue impacts for Swiss formula 5 and 15



♦ Swiss formula with coefficient of 5 ○ Swiss formula with coefficient of 15

Source : GTAP simulation

109. While, again, this kind of comparison runs the risk of "comparing apples with oranges" it shows what magnitudes of revenue and welfare impacts may be associated with certain options. It will be ultimately up to individual countries to decide how much they value a prospective welfare gain stemming from allocative efficiency against the costs of compensatory fiscal adjustment necessary to replace the forgone tariff revenue with other taxes.

Distinguishing between agricultural and industrial tariffs

110. The contributions of tariff liberalisation in agricultural and industrial sectors to estimated revenue and welfare changes can be estimated by simulating separately tariff reductions in these two sectors. As far as the world economy is concerned, the lowering of tariffs in agriculture according to the Swiss formula with a coefficient of 10, results in higher welfare gains than a comparable lowering of tariffs in industrial products (see Annex Table 13). This result is however driven by relatively high gains from agricultural liberalisation accruing to developed countries where agricultural market access is more distorted in the baseline. Nevertheless, liberalisation of industrial tariffs is more important from the point of view of developing countries which derive 58% of their welfare gains from lowering of tariffs in manufacturing sectors.[39] In developed countries the corresponding share amounts to 38% (see Annex Tables 12 and 13).

[39] This lends support to the argument of Hertel and Martin. (1999) that from the point of view of developing countries, the potential for welfare gains may be much more extensive in reduction of manufacturing tariffs than agricultural tariffs. The importance of market access in manufactured products stems from the high, and still increasing, shares of manufacturing in developing countries' production, exports and imports. .

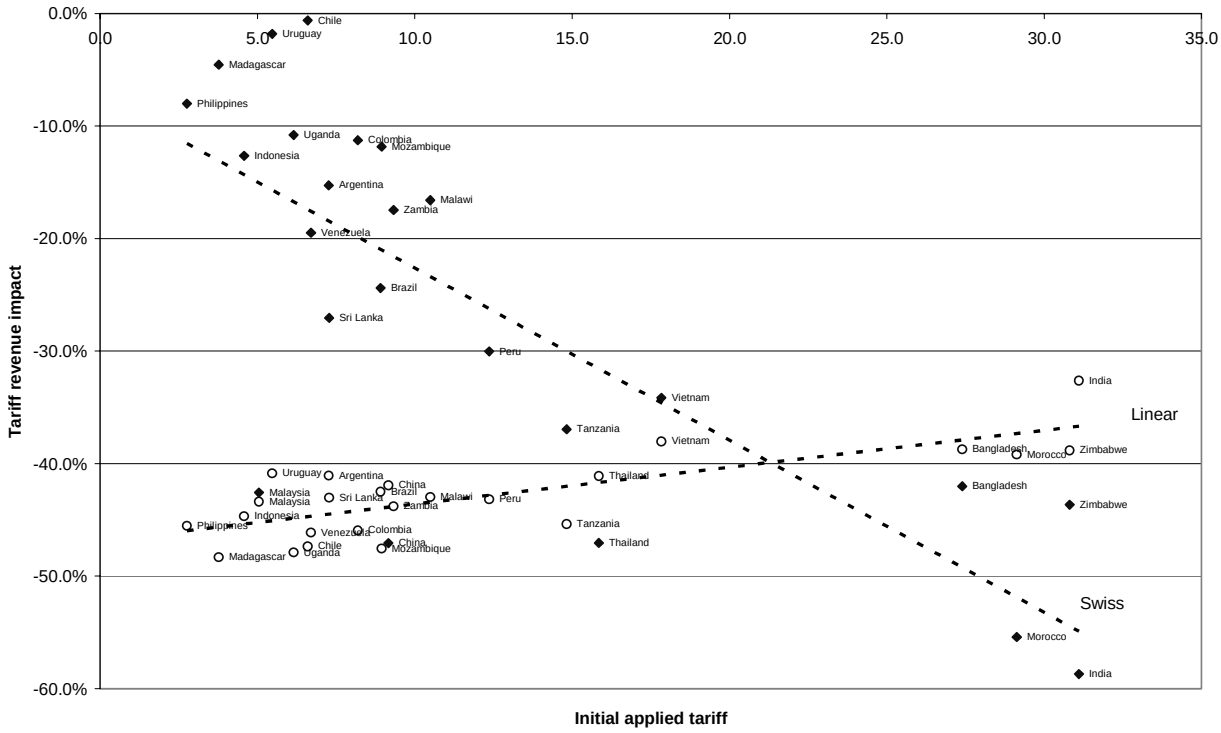
111. Although several developing countries maintain relatively high *ad valorem* tariffs on primary and processed agriculture (see Annex Table 14), the shares of agricultural imports in total imports are generally low (see Annex Table 15). As a result, the overall contribution of agriculture to tariff revenue does not typically exceed 30% in the sample of developing countries considered here. Simulation results presented in Annex Table 12 indicate that impacts on developing countries' tariff revenue associated with agricultural tariff lowering are relatively moderate and on average amount to 5% for the Swiss formula with a coefficient of 10 (bottom of Annex Table 13). A comparable reduction of manufacturing tariffs results in an average reduction of tariff revenue by 20%. Nevertheless, the 5% average for agricultural liberalisation masks significant diversity among selected developing countries: Brazil, Uruguay and Argentina record increases in tariff revenue collections of around 2-5 % while Thailand and Sri Lanka record significant reductions of, respectively, 15 and 17%.

Swiss and linear formulas compared

112. As discussed above the *linear formula* has the property of yielding higher absolute cuts of initially high tariffs but both high and low rates are cut in the same proportion thereby carrying over the initial dispersion across sectors and countries. The *Swiss formula* is a non-linear formula and has a number of desirable properties. It maintains the advantage of the *linear formula* of decreasing high tariffs by more in absolute terms but it also does so in relative terms offering a more effective reduction of tariff dispersion.

113. As explained in the Technical Annex, if two countries are characterised by a similar aggregate import demand elasticity but maintain different initial tariff levels, a linear formula implies that the high tariff country will experience a smaller percentage revenue loss and a larger percentage increase in imports as compared to a low tariff country. This result does not obtain when the Swiss formula is used. For the range of Swiss formula coefficients and import demand elasticites analysed here the relationship is negative implying that a high tariff country will experience a deeper percentage loss of tariff revenue. This effect is confirmed by the graphical comparison of simulations results presented in Annex Table 16 and in Figure 18 below. The negative revenue effects associated with the linear formula with a coefficient of 50% decrease with the level of initial tariff and are concentrated around -40% level while the negative revenue effects associated with the Swiss formula increase with the level of initial tariff and range from 0 to 60%.

Figure 18. Swiss and linear formula compared – initial tariff and revenue impacts

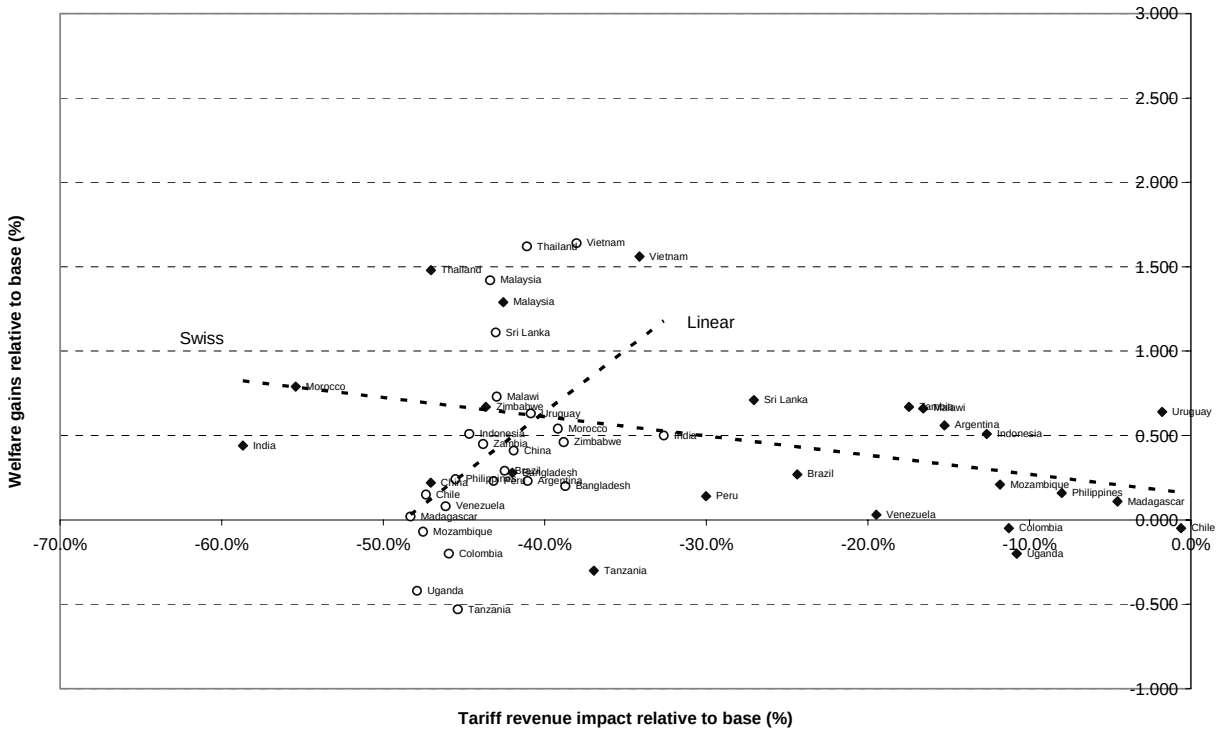


♦ Swiss formula with coefficient of 10 ○ Linear formula (50% cut)

Source : GTAP simulation

114. Simulation results of tariff reduction using the linear formula also indicate considerable disparities in trade and welfare impacts across countries. It is interesting to point out that reduction of tariffs according to the linear formula with a coefficient of 50% yields global welfare gains that are comparable to those achieved with the Swiss formula with a coefficient of 10 (see averages at the bottom of Annex Table 16). In the case of the Swiss formula, the average developing country gain in welfare relative to base amounts to 0.43% of per capita welfare annually while for the linear formula, the corresponding estimate is 0.42%. The Swiss formula, however, yields more favorable revenue effects in developing countries amounting to on average -25%. The corresponding estimate for the linear formula is -43%. As can be seem in Figure 19 in the case of the Swiss formula, countries that enjoy higher relative welfare gains face more substantial revenue reductions. In the case of the linear formula, countries that gain the most tend to experience lower percentage tariff revenue reductions.

Figure 19. Swiss and linear formula compared – welfare and revenue impacts



♦ Swiss formula with coefficient of 10 ○ Linear formula (50% cut)
Source : GTAP simulation

115. In addition to estimations of tariff reductions according to the linear formula, Annex Table 16 includes results for the so called *flexible Swiss formula* which is a variation of the Swiss formula (Francois and Martin, 2003). In addition to preserving the attributes of the standard Swiss formula of the uniform maximum equal to the *a* parameter and higher proportional cuts to higher rates, the *flexible Swiss formula* introduces more flexibility with respect to the depth of cuts (see Box 2). Results presented in Annex Table 16 pertain to two values of parameter *b*: 0.5 and 1.5.

Interpreting the simulation results

116. While interpreting the simulation results it is important to reiterate that reducing tariffs brings welfare gains, net of any losses in tariff revenues and these gains are the ultimate motivation for tariff reform. The estimated percentage tariff revenue impacts could, however, be indicative of the extent of required fiscal adjustment. The required fiscal adjustment will depend on a given percentage impact on tariff revenue and shares of tariff revenues in the total government revenue and GDP.

117. To facilitate the interpretation of the simulation results, Table 2 below presents the inferred percentage impacts on total government revenue and estimated tariff revenue changes as a per cent of GDP. These estimates are based on simulation results presented in Annex Table 9 and shares of import duties in total government revenues and GDPs presented in Annex Table 1. The coverage of the IMF Government Finance Statistics data enables such calculations for 12 out of the 24 developing economies considered in this paper.

Table 2. Estimating the magnitude of the required fiscal adjustment

	Customs and other import duties		Simulated percentage impact on tariff revenue (%)			Estimated impact on revenue (%)			Estimated impact on tariff revenue as a % of GDP		
	% of revenue	% of GDP	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15
Argentina	4%	1%	-45%	-15%	-4%	-1.8%	-0.6%	-0.2%	-0.3%	-0.1%	0.0%
Brazil	3%	1%	-53%	-24%	-10%	-1.6%	-0.7%	-0.3%	-0.4%	-0.2%	-0.1%
Chile	4%	1%	-35%	-1%	-1%	-1.4%	0.0%	0.0%	-0.3%	0.0%	0.0%
Colombia	5%	1%	-44%	-11%	-4%	-2.2%	-0.6%	-0.2%	-0.4%	-0.1%	0.0%
India	15%	2%	-75%	-59%	-48%	-11.2%	-8.8%	-7.2%	-1.3%	-1.1%	-0.9%
Indonesia	3%	1%	-26%	-13%	-9%	-0.8%	-0.4%	-0.3%	-0.2%	-0.1%	-0.1%
Madagascar	26%	3%	-15%	-5%	-3%	-3.9%	-1.2%	-0.7%	-0.4%	-0.1%	-0.1%
Morocco	16%	5%	-74%	-55%	-42%	-11.8%	-8.9%	-6.7%	-3.5%	-2.6%	-2.0%
Peru	9%	1%	-58%	-30%	-11%	-5.2%	-2.7%	-1.0%	-0.8%	-0.4%	-0.2%
Thailand	10%	2%	-66%	-47%	-35%	-6.6%	-4.7%	-3.5%	-1.2%	-0.8%	-0.6%
Uruguay	3%	1%	-27%	-2%	1%	-0.8%	-0.1%	0.0%	-0.2%	0.0%	0.0%
Venezuela	5%	1%	-52%	-19%	-3%	-2.6%	-1.0%	-0.2%	-0.6%	-0.2%	0.0%

Source: GTAP simulations and IMF International Financial Statistics data

118. The share of customs duties in total government revenue ranges from 3 per cent in Indonesia, Brazil and Uruguay to 26 per cent in Madagascar. The shares of customs duties in GDPs are typically in the range of 1-2 per cent of GDP with exception of Madagascar and Morocco where these shares are 3 and 5 per cent respectively. Estimated percentage impacts of tariff cuts according to Swiss formula with a coefficient of 15 range from a 1 per cent gain in Uruguay to 48 per cent reduction in India. The combined impacts on total government revenue range from close to 0 per cent in Uruguay to -7 per cent in India.

119. Nine out of the twelve countries for which such a calculation can be performed are not affected in a significant way; negative impacts on tariff revenue are in the range of 0 to 0.2 per cent of GDP and percentage impacts on total government revenue are in the range of 0 to 1 per cent in the case of Swiss formula with a coefficient of 15. Three countries (Morocco, India and Thailand) stand out as being likely to be affected disproportionately by the investigated tariff cut scenario. Swiss formula with a coefficient of 15 is estimated to generate tariff revenue reductions that account for 2, 0.9 and 0.6 of respective GDPs. The associated reductions in total government revenues are estimated at 6.7, 7.2 and 3.5 per cent respectively.

120. The presented results suggest that in majority of cases the potential tariff revenue reductions are manageable, especially given the net efficiency gains that are expected to result from liberalization. In selected countries, however, the required fiscal adjustment may be more extensive.

Tariff liberalisation with an accompanying consumption tax replacement policy

121. Since the ultimate objective of multilateral tariff reduction is their complete removal, the recent policy advice stressed the use of other taxes as a compensating measure. As we have discussed above, most countries, including the poorest ones, have for some time now been moving away from trade taxes towards other forms of taxation such as income, sales or value added taxes (Figure 2). The tendency to shift away from trade taxes towards domestic consumption and income taxes reflects the fact that trade taxes are a relatively inefficient form of raising revenue. Trade taxes distort both consumption and production but apply to a relatively narrow base. Since at the aggregate level trade must equal the difference between domestic production and consumption, taxes applied to either production or consumption would have the advantage of being relatively broadly based as compared to trade taxes that apply to the difference between domestic production and consumption.

122. In this context, Annex table 17 compares the relative size of private household consumption and imports. We observe that in the great majority of countries in our sample imports account for less than 25%

of private consumption. In the Philippines, Singapore and Malaysia these ratios are 27, 48 and 78%, respectively. These ratios indicate that, at least theoretically, private consumption provides a much wider tax base and that it is possible to switch from import duties towards consumption tax in such a way that trade is less distorted and allocation of resources and welfare improved while at the same time preserving government revenue.

123. In what follows we discuss results of a simulation of the welfare effects of reducing tariffs according to the three adopted Swiss formulas and simultaneously replacing tariff revenue with revenues from consumption tax. In this respect the GTAP model offers a convenient feature of swapping the consumption tax variable which is assumed to be exogenous in the original closure[40] of the model with the ratio of tax revenue to national income. Such a closure of the model mimics a situation where in each country, in addition to implementing a tax reform, the authorities raise the tax rate on private consumption to the extent that is necessary to keep the share of tax revenue to national income unchanged. We refer to such a tariff reduction as revenue neutral tariff reduction.

124. In the GTAP model, government spending is not linked to government balance. Instead, the government spending depends on regional income. Hence, it is possible that tax revenue loss will be consistent with an increase in government consumption if the analyzed policy change results in an increase in regional income. This feature of the model is considered to be one of its shortcomings. It can however be argued that this feature is as problematic for the analysis of tariff revenue implications as it is for any other application of the model. Not accounting explicitly for a budget constraint may certainly affect a whole range of estimates. The experiment of a revenue-neutral tariff reduction described in the previous paragraph partially solves this problem. While even in this experiment the government consumption is likely to increase with regional income, we introduce a constraint of tariff revenue replacement which should partially correct the estimates of welfare. As can be seen in Annex Tables 18 and 19, such an approach lowers welfare change estimates obtained from the simulation without a tax replacement policy.[41] The differences in welfare estimates between the non-replacement and replacement case are country specific and depend on the relative size of tax bases associated with the consumption tax and import duty (see Annex Table 17) as well as the relative magnitudes of initial distortions associated with the two taxes. Hence, we expect that the revenue replacement policy will result in varying degrees of correction of initial welfare estimates.

125. One other major limitation of the GTAP database is the incompleteness of the government accounts and the absence of tax data content even in many places where the database structure makes provision for it (Hertel and Walmsley, 2004). The GTAP is currently working on the incorporation into the database of more accurate tax data that would allow more satisfactory simulations of policies with tax replacement (Hertel and Walmsley, 2004). Currently, the representation of consumption tax in the GTAP database is at best patchy. Indeed, Annex Table 20 shows the initial ad valorem tax rates on private domestic consumption indicating that the data are not available for a large number of countries in our sample. The simulation of the revenue replacement for countries with initial tax rates set at zero effectively implies introducing a uniform consumption tax. For countries for which the data is available, the simulation of revenue replacement implies a uniform percentage increase in the power[42] of the consumption tax across sectors with the consequence that initial distortions associated with this tax (*e.g.* one sector being taxed more heavily than others) affect the results of the simulation.

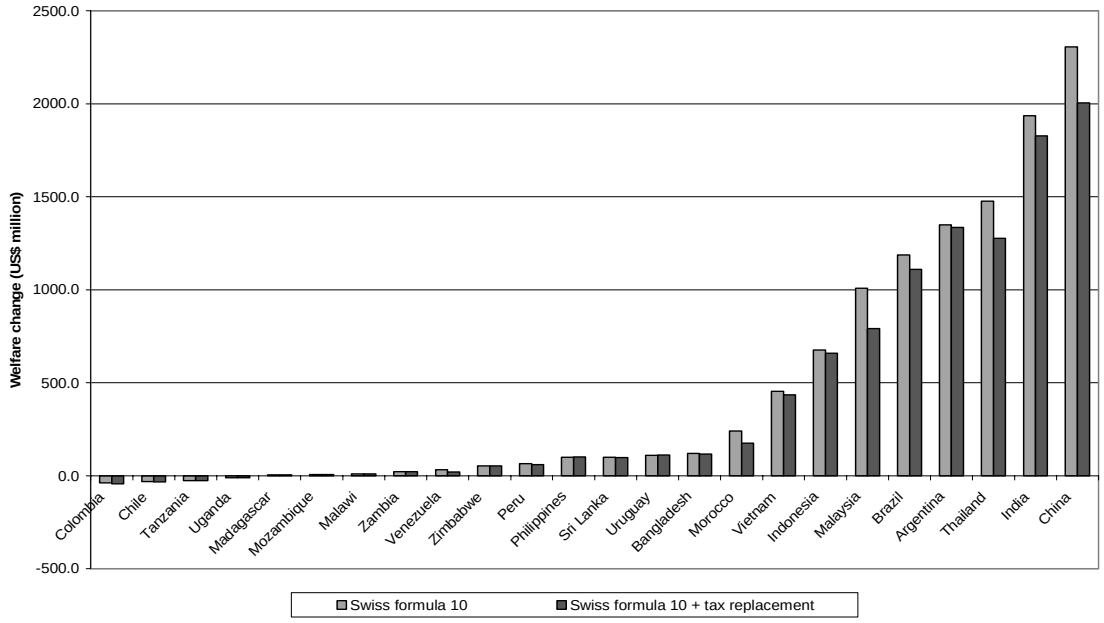
[40] Closure is a selection of variables which are determined outside the model (exogenous) such as for example the tariff rate and variables determined by the model (endogenous) such as for example consumption or welfare.

[41] In fact, increase in any tax in the model introduces an additional distortion and results in welfare decrease.

[42] The power of tax is defined as $100+t$ where t is the initial percentage ad valorem rate.

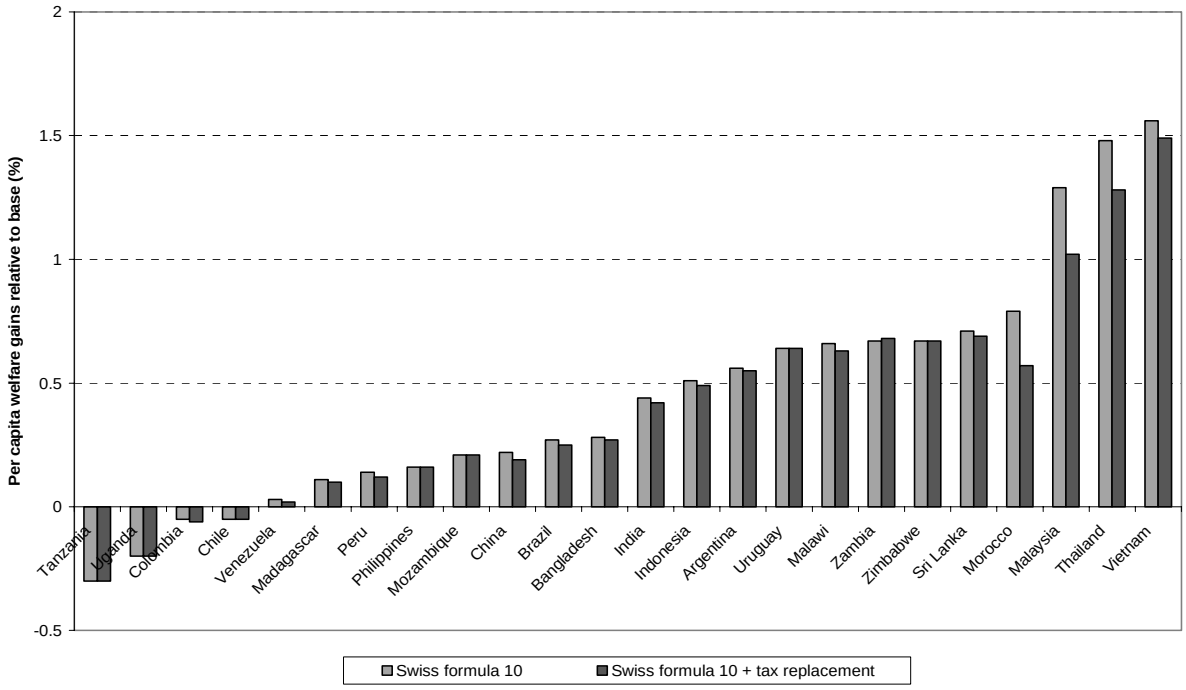
126. Annex Table 18 compares welfare and trade effects of Swiss formula tariff reductions under the assumption of no tax replacement with those obtained under the assumption of replacement with the consumption tax. Annex Table 19 offers a comparison of percentage per capita welfare changes between the two scenarios. Figure 20 and 21 below offer graphical summary of the two methods for reduction of tariffs according to Swiss formula with the coefficient of 10.

Figure 20. Comparison of the welfare results between the base Swiss formula 10 scenario and a Swiss formula 10 scenario with a tariff revenue replacement with consumption tax



Source : GTAP simulation

Figure 21. Comparison of the welfare gains relative to base between the base Swiss formula 10 scenario and a Swiss formula 10 scenario with a tariff revenue replacement



Source : GTAP simulation

127. The introduction of a tax replacement scenario does not change the sign of welfare estimates. However, as a result of varying imports to consumption ratios (Annex Table 17) as well as varying initial distortions associated with tariff and consumption tax structures (see above) the welfare implications of tax replacement scenario vary by country. On a per capita basis, considerable corrections are expected for example in Morocco and Malaysia. Morocco with high initial tariffs and relatively high imports to consumption ratio will have to raise consumption tax relatively more as compared to other countries. As a result, in Morocco's case the replacement of tariff revenue with consumption tax could reduce the initially estimated per capita welfare gain by around 27%. In Malaysia, on the other hand, despite its relatively low initial tariff level (5%) the very high imports to consumption ratio, would also imply a reduction of the initial welfare estimate by around 26% (compare Annex Table 19). The results are also affected by the quality of the initial tax data. For Morocco the database includes initial tax rates while for Malaysia it does not (see Annex Table 20). Hence, the estimate of the welfare cost of revenue replacement policy in Morocco will take into account the initial distortions associated with the consumption tax while the estimate for Malaysia will not.

128. Bearing in mind the qualifications associated with the data quality, our results suggest that, if such a tax replacement policy can indeed be introduced there is scope for obtaining welfare gains from tariff liberalisation without compromising government revenue. For most countries across our sample an accompanying tax replacement policy only partially reduces the welfare gains associated with better allocation of resources arising from tariff reform. To what extent these gains are reduced is country specific. Nevertheless, since consumption provides a wider tax base, in principle it should be possible to switch from trade taxes towards consumption or income tax in such a way that trade is less distorted, allocation of resources and welfare improved and revenue unchanged.

VIII. Conclusions

129. The literature points to the strong economic case for a non-discriminatory tariff reform that, if necessary, should be accompanied by a reform of the tax system. Developing countries that currently tend to maintain higher and more dispersed tariff barriers, are particularly well positioned to benefit from a tariff reform but they are also more vulnerable to the associated interim tariff revenue loss. The sensitivities associated with the fiscal implications of tariff liberalisation in developing countries need to be addressed be it by an appropriate design of tariff reduction modalities and/or by providing assistance in the implementation of a tariff-policy-cum-tax-reform package.

130. Since the revenue impact of tariff liberalisation depends on the initial structure of tariffs, the design of the liberalisation scenario and the overall impact of liberalisation on production, consumption and trade in the concerned economy, it is not evident whether, to what extent and which developing countries may be affected by a tariff revenue loss. This paper's main objective is to shed more empirical light on the nature and scope of this problem with the objective of facilitating the DDA negotiations.

131. First, the fact that in several developing countries many tariffs have not been bound or have been bound at rates that are significantly higher than applied duties highlights the need to seek ambitious tariff liberalisation commitments in the context of the Doha round of negotiations in order to secure meaningful welfare gains for participants. At the same time, large binding overhangs imply that unused protection can be significantly reduced contributing to greater certainty about the future levels of tariff protection without implying any losses to government tariff revenue

132. Second, many developing countries' applied tariff schedules are characterised by high dispersion of tariff rates in low import demand elasticity sectors and prevalence of high tariff rates in high import demand elasticity sectors. Such a structure of applied rates may in fact lessen any negative revenue impacts of tariff reduction as compared to a situation where high rates are applied on low elasticity products.

133. The results of simulations of reduction of tariffs according to Swiss formula indicate considerable cross-country differences in trade, welfare and revenue impacts. We illustrate that to a large extent these differences are driven by differences in the initial levels of applied tariffs and by differences between bound and applied rates (binding overhangs). In particular, countries with higher initial tariffs and lower binding overhang experience deeper percentage revenue loss but also larger trade creation and welfare gains. Cross-country variation in revenue impacts does not seem to be driven by differences in these countries' aggregate responsiveness to trade price changes calculated on the basis of available trade elasticties. The link between the initial level of tariffs and the depth of proportional revenue reduction where high tariff countries experience deeper percentage reduction in tariff revenue (and at the same time larger trade creation and welfare gains) can be associated with properties of the Swiss formula for tariff cuts and the assumed trade elasticties and does not extend to the case of linear formula.

134. As far as sensitivity to the Swiss formula coefficient is concerned, for the majority of countries in our sample a more ambitious tariff cut is likely to bring higher welfare gains but may also result in higher percentage of forgone revenue. For some countries additional welfare gains associated with a more ambitious Swiss formula coefficient are more "expensive" than for others in the sense that they lose a relatively high percentage of revenue but gain a relatively small percentage of additional welfare gain. While this sort of comparison runs the risk of "comparing apples with oranges" it shows what magnitudes of revenue impacts and welfare impacts may be associated with certain options.

135. The required fiscal adjustment will depend on a given percentage impact on tariff revenue and shares of tariff revenues in the total government revenue and GDP. Estimates for 12 countries in our sample indicate that in nine cases the potential tariff revenue reductions are relatively small and the

required fiscal adjustment is therefore manageable, especially given the net efficiency gains that are expected to result from liberalization. In some cases, however, the required fiscal adjustment may be more extensive.

136. The results of the simulation of reducing tariffs according to the Swiss formula and simultaneously replacing tariff revenue with consumption tax indicate that there is significant scope for obtaining positive welfare gains from the joint package of tariff and tax reform without compromising public revenue. For many countries an accompanying tax replacement policy would only partially reduce welfare gains arising from improvements to allocation of resources associated with tariff reform. To what extent these gains are reduced is country-specific. In particular, it depends on the initial reliance on tariff revenues, the relative size of the consumption and import tax bases and the relative size of initial distortions associated with import and consumption taxes. Provided that an appropriate tax replacement policy can be designed and implemented, the costs of such operation are temporary while the gains from an improved allocation of resources are permanent. Therefore, from an economic point of view, these costs should not be seen as an obstacle to tariff reform but rather as investment necessary to enable the realisation of long term gains. Countries which are currently incapable of financing such a reform should be assisted by the international community.

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DATA ANNEX

The data set used in partial equilibrium exercise

The partial equilibrium simulations are based on the TRAINS tariff line data for the HS combined nomenclature extracted from the Word Integrated Trade Solution facility.

More information on WITS is available at: http://wits.worldbank.org/

Trade and tariff reference years in the partial equilibrium simulations are:

Argentina	2002	Peru	2000
Bangladesh	2002	Philippines	2002
Brazil	2002	Sri Lanka	2001
Chile	2002	Tanzania	2000
China	2001	Thailand	2001
Colombia	2002	Madagascar	2001
India	2001	Uganda	2002
Indonesia	2001	Uruguay	2001
Malawi	2001	Venezuela	2000
Malaysia	2001	Vietnam	2001
Morocco	2002	Zambia	2002
Mozambique	2002	Zimbabwe	2001

The data set used in general equilibrium exercise

The data set used in general equilibrium simulations is preliminary release of the GTAP Version 6 database (6.02) benchmarked to 2001. At the time of completion of this paper the final version 6 has not yet been released.

The data set covers a total of 86 geographic areas which are comprised of single or multi-economy groupings and 57 sectors. As described in the main body of the paper, these geographic areas and sectors are aggregated to facilitate analysis of the results (see Annex Table 4 and 5). For more information on the GTAP resources see www.gtap.org.

TECHNICAL ANNEX

Tariff Reform and Government Revenue - The Partial Equilibrium Approach

Elasticity of import demand can be expressed as:

$$(1)\ \varepsilon_m = -\frac{\hat{M}}{\hat{P}}$$

where $\hat{M}, \hat{P}$ denote proportional changes in imports volume and price of imports. Domestic price is assumed to defined as a mark-up over the world price P*:

$$(2) P = P^*(1+t) \Rightarrow \hat{P} = \hat{P^*} + \frac{dt}{1+t}$$

The proportional change in imports volume can then be expressed as:

$$(3) \hat{M} = \frac{dM}{M} = -\varepsilon_m \hat{P^*} - \varepsilon_m \frac{dt}{1+t}$$

The first term of the right hand side in (3) equals 0 if the world price is assumed fixed (equivalent to the assumption of infinite export supply elasticity). Hence, change in imports is a function of the initial trade level import elasticity of demand and the change in tariff. That is,

$$(4)\ dM = -M\varepsilon_m \frac{dt}{(1+t)}$$

Change in government revenue can then be expressed as:

$$(5)\ dG = G_1 - G_0 = t_1 M_1 - t_0 M_0$$

where subscripts denote time periods (0 – before tariff change and 1 – after tariff change). Replacing in (4) the change in M by $M_1 - M_0$ and manipulating results in:

$$(6)\ M_1 = M_0 - M_0 \varepsilon_m \frac{dt}{(1+t_0)}$$

Substituting equation (6) into (5) and manipulating:

$$(7)\ dG = M_0 \left[t_1 \left(1 - \varepsilon_m \frac{dt}{(1+t_0)} \right) - t_0 \right]$$

Hence, the change in tariff revenue is a function of the initial tariff, the initial value of trade, change in tariff and import elasticity of demand.

Extending this approach to the entire tariff schedule of a given country (7) can be written as follows:

(8) $dG = \sum_i M_{0i}\left[t_{1i}\left(1-\varepsilon_{mi}\frac{dt_i}{(1+t_{0i})}\right)-t_{0i}\right]$

It is also convenient to express (7) and (8) in proportional terms:

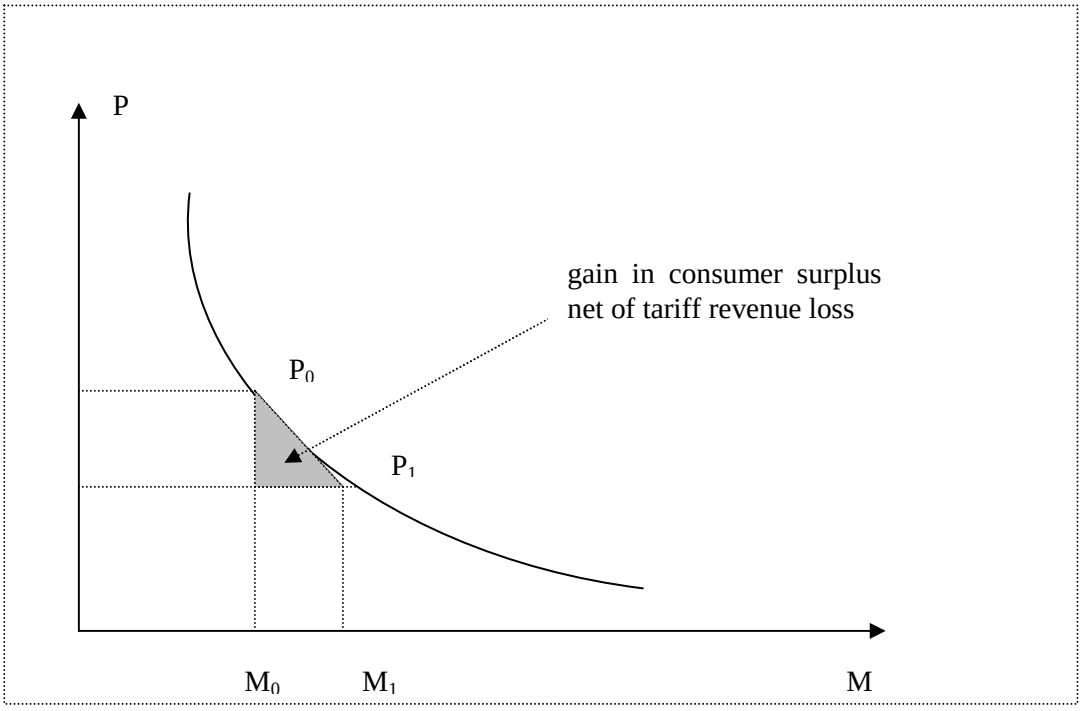
(9) $\frac{dM}{M} = -\varepsilon_m \frac{dt}{(1+t)}$ and (10) $\frac{dG}{G} = \frac{t_1}{t_0}\left(1-\varepsilon_m\frac{dt}{(1+t_0)}\right)-1$

Welfare change estimate

Welfare change is estimated as the sum of tariff line changes to consumer surplus net of changes to import tariff revenues.

(10) $dW = \frac{1}{2} dM * dP * sign(dP)$

Figure 1. Welfare change estimation



Because we define the price of the product to be 1 in the benchmark equilibrium (10) can be rewritten as:

(11) $dW = -\frac{1}{2} M_0 \varepsilon_m \left[\frac{dt}{(1+t_0)}\right]^2 * sign(dP)$

Linear cut

Linear formula gives the following relationship between the initial and resulting rate:

$t_1 = ct_0$ where 0<c<1

Hence (10) becomes:

(12) $\frac{dG}{G} = t_0(1 - c\varepsilon_m) + 1$

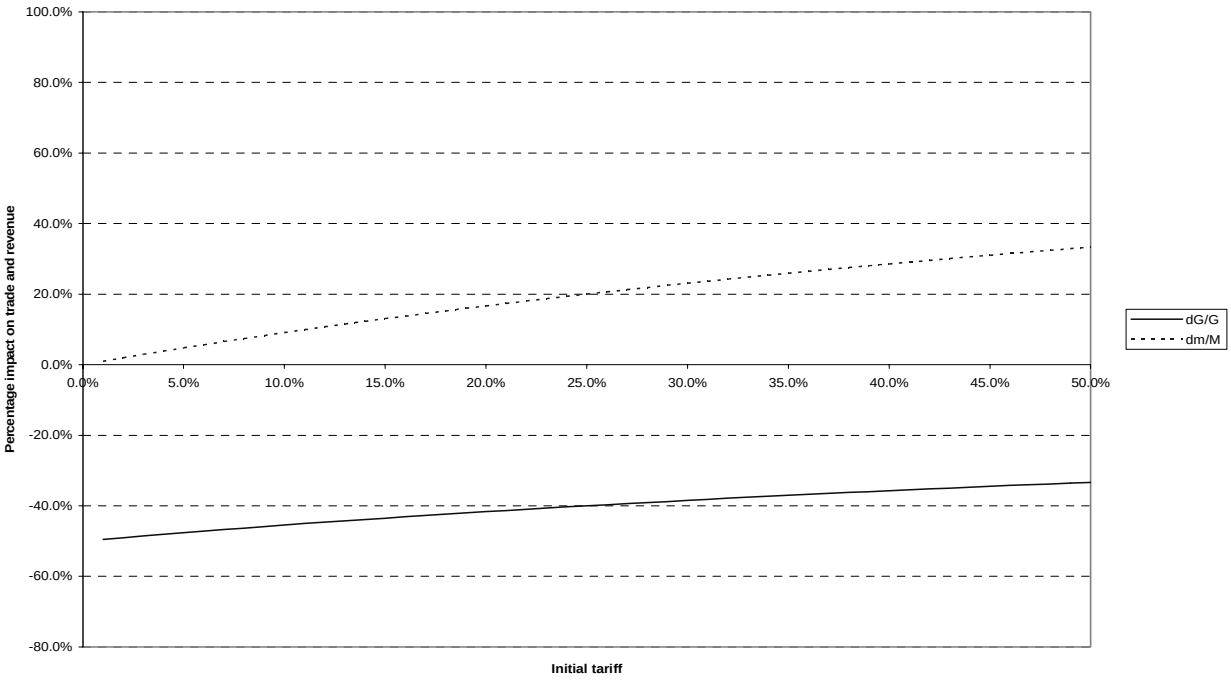
which gives the following condition for the change in revenue to be positive $t_0(1 - c\varepsilon_m) < -1$

and the following condition for the proportional change in revenue to be increasing

(13) $\frac{\frac{dG}{G}}{dt_0} = \frac{-t_0\varepsilon_m c(c-1)}{(1+t_0)^2} > 0$ for all positive t_0, ε_m and $0<c<1$

(13) implies that in the case of a linear formula the impact on revenue increases with the initial level of tariff. For negative impacts, higher initial tariff rates will result in lower revenue losses. The figure presented below demonstrates the relationship between the initial tariff and the percentage revenue impact for import demand elasticity of 2 and c=0.9 (*i.e.* 10% linear cut).

Figure 2. Percentage trade and revenue effects and the level of initial tariff – linear formula.



Swiss formula

The Swiss formula implies that:

$$t_1 = \frac{at_0}{a + t_0}$$

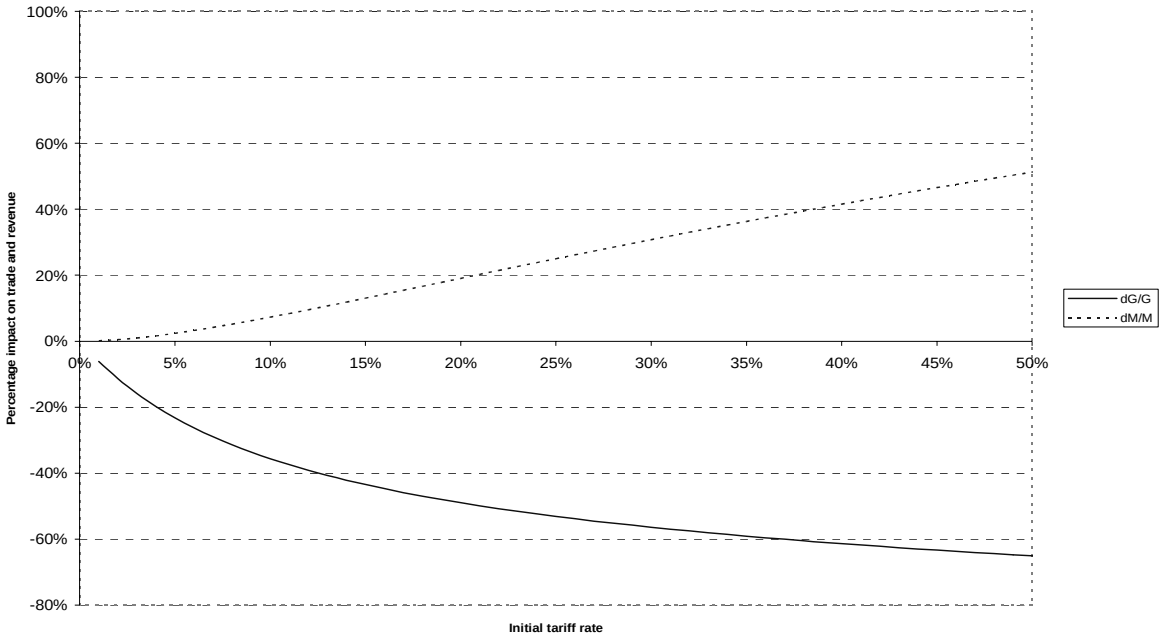
which yield the following proportional changes of trade and revenue as expressed in terms of the initial tariff rate and the Swiss formula coefficient *a*:

(14) $\frac{\Delta M}{M} = \varepsilon_m \frac{t_0^{\,2}}{(1+t_0)(a+t_0)}$ and (15) $\frac{\Delta G}{G} = \frac{a\varepsilon_m t_0^{\,2} - t_0(a+t_0)(1+t_0)}{(a+t_0)^2(1+t_0)}$

The percentage change in revenue in the Swiss formula case is a complex expression (see equation 15). It can be shown that contrary to the linear tariff cut formula, depending on the combinations of the Swiss formula coefficient *a*, import demand elasticity ε_m and the initial tariff t_0 the derivative of (14) with respect to t_0 is either positive or negative. This implies that, depending on the three parameters, there may exist either a positive or a negative relationship between the impact on revenue and the initial tariff. Below we plot the relationship between the initial tariff and the percentage change in revenue for two sets of parameters.

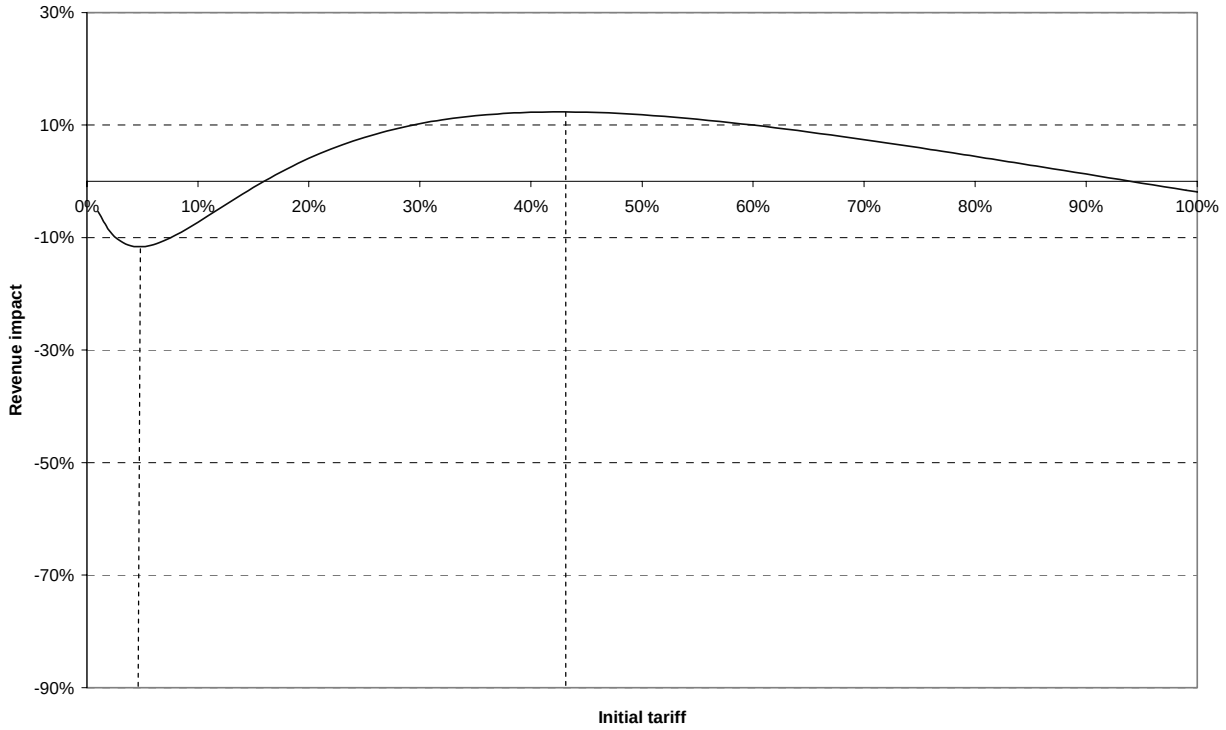
In Scenario 1 *a*=15 and import demand elasticity ε_m =2. In this scenario import demand elasticity is equal to the average trade-weighed import demand elasticity calculated for the analysed sample of countries.

Figure 3. Percentage trade and revenue effects and the level of initial tariff – Swiss formula 15 and import demand elasticity of 2



In Scenario 2 maintains the same Swiss formula coefficient of 15 but assumes a much higher import demand elasticity of 15.

Figure 4. Percentage trade and revenue effects and the level of initial tariff – Swiss formula 15 and import demand elasticity of 15.



Two observations can be drawn form the last to figures. First, as in the linear formula case, the Swiss formula, depending on the import demand elasticity, can result in positive revenue effects for certain initial tariff rates. Second, this formula generates a much more complex relationship between the initial rate and the percentage impact on the government revenue. For some tariff ranges, the revenue impact may be increasing or decreasing with the level of initial tariff (marked in the Figure with vertical grid).

An implication of the latter observation is that if two countries are characterised by the same level of import demand elasticity but have different initial tariff levels, a linear formula cut will generate smaller revenue loss (or larger revenue gain) in a country with higher initial level of tariffs. This however can not be guaranteed with the Swiss formula since for tariffs in some range high tariff country may experience a smaller revenue loss (Figure 4).

However, for a combination of the Swiss formula coefficient of 15 and import demand elasticity of 2 this relationship is negative implying that a high tariff country will experience a deeper proportional loss of revenue.

STATISTICAL ANNEX

Annex Table 1. Reliance on customs duties and international trade taxes in selected economies

	Reference year	Taxes on international trade and transactions as % of taxes	Taxes on international trade and transactions as % of revenue	Customs and other import duties as % of taxes	Customs and other import duties as % of revenue	Customs and other import duties as % of GDP	Revenue as % of GDP	Taxes as % of GDP	Taxes on international trade and transactions as % of GDP
Albania	1998	25%	14%	23%	13%	..	..	..	..
Argentina	2001	6%	4%	6%	4%	0.6%	13.8%	9.3%	0.6%
Azerbaijan	1999	12%	8%	12%	8%	..	..	..	..
Bahrain, Kingdom of	2002	36%	5%	36%	5%	1.6%	35.5%	4.5%	1.6%
Belarus	2002	14%	8%	0%	0%	0.0%	26.6%	14.2%	2.0%
Bhutan	2003	4%	1%	3%	1%	0.3%	35.9%	9.1%	0.3%
Bolivia	2001	7%	4%	7%	4%	0.9%	19.7%	12.0%	0.9%
Brazil	1998	6%	3%	6%	3%	0.7%	24.2%	12.2%	0.7%
Bulgaria	2001	4%	2%	4%	2%	0.7%	34.3%	17.5%	0.7%
Burundi	1999	23%	17%	18%	13%	2.4%	18.3%	13.6%	3.2%
Chile	2002	6%	4%	..	..	..	21.4%	16.6%	0.9%
China,P.R.:Macao	2003	0%	0%	0%	0%	0.0%	24.1%	20.9%	0.0%
Colombia	2000	7%	5%	7%	5%	1.0%	18.5%	13.4%	1.0%
Congo, Dem. Rep. of	2002	36%	27%	33%	25%	1.3%	8.9%	3.9%	1.4%
Congo, Republic of	2002	23%	6%	21%	5%	1.7%	32.3%	8.4%	1.9%
Costa Rica	2002	8%	5%	6%	4%	0.8%	21.5%	13.2%	1.0%
Côte d'Ivoire	2001	48%	41%	30%	26%	4.5%	17.5%	14.9%	7.1%
Croatia	2001	10%	6%	10%	6%	2.6%	39.5%	24.4%	2.6%
Dominican Republic	2001	34%	31%	33%	30%	5.1%	17.3%	15.6%	5.3%
El Salvador	2001	9%	6%	9%	6%	0.1%	2.1%	1.4%	0.1%
Georgia	2002	9%	6%	9%	6%	..	..	..	..
India	2002	19%	15%	19%	15%	1.8%	12.5%	9.5%	1.8%
Indonesia	2001	5%	3%	5%	3%	0.6%	21.2%	13.2%	0.7%
Iran, I.R. of	2002	34%	8%	34%	8%	2.3%	29.0%	6.9%	2.3%
Israel	1999	1%	1%	1%	1%	0.3%	43.2%	28.8%	0.3%

Source: OECD Secretariat based on IMF Government Finance Statistics and International Finance Statistics. Indicators , customs and import duties data and revenue refers to central government only, the reference period is the latest available year in period 1998-2003.

Annex Table 1. Reliance on customs duties and international trade taxes in selected economies (continued)

	Reference year	Taxes on international trade and transactions as % of taxes	Taxes on international trade and transactions as % of revenue	Customs and other import duties as % of taxes	Customs and other import duties as % of revenue	Customs and other import duties as % of GDP	Revenue as % of GDP	Taxes as % of GDP	Taxes on international trade and transactions as % of GDP
Jamaica	2002	10%	8%	10%	8%	2.7%	34.4%	27.0%	2.7%
Kazakhstan	2002	8%	7%	5%	4%	0.6%	14.8%	12.4%	1.0%
Lesotho	2003	49%	39%	0%	0%	..	42.0%	33.5%	16.5%
Madagascar	2002	45%	36%	32%	26%	2.5%	9.6%	7.7%	3.5%
Maldives	2003	62%	24%	62%	24%	..	..	..	..
Mauritius	2003	25%	20%	25%	20%	4.1%	20.9%	16.6%	4.1%
Moldova	2001	10%	5%	8%	4%	1.0%	23.6%	12.2%	1.2%
Mongolia	2001	13%	7%	13%	7%	2.3%	32.5%	18.3%	2.4%
Morocco	1999	20%	16%	20%	16%	4.7%	29.6%	23.5%	4.7%
Myanmar	2000	7%	4%	7%	4%	0.2%	5.6%	2.8%	0.2%
Nepal	2003	34%	23%	32%	22%	3.0%	13.5%	9.4%	3.2%
Nicaragua	2002	11%	6%	11%	6%	1.5%	23.8%	13.6%	1.5%
Pakistan	2003	13%	9%	13%	9%	1.7%	18.9%	13.1%	1.7%
Panama	2001	24%	9%	24%	9%	2.2%	25.8%	9.3%	2.2%
Peru	2001	12%	9%	12%	9%	1.4%	16.2%	12.3%	1.4%
Romania	2001	7%	3%	7%	3%	0.8%	26.8%	11.7%	0.8%
Russia	2001	24%	14%	7%	4%	..	..	..	..
Serbia & Montenegro	2002	11%	7%	11%	7%	..	..	..	..
Singapore	2002	3%	2%	3%	2%	0.4%	22.2%	13.3%	0.4%
South Africa	2002	3%	3%	3%	3%	..	..	..	..
Syrian Arab Republic	1999	14%	10%	12%	9%	2.0%	23.9%	17.4%	2.4%
Tajikistan	2001	22%	16%	21%	16%	..	..	..	..
Thailand	2002	13%	10%	12%	10%	1.8%	17.3%	14.3%	1.8%
Tunisia	2002	12%	9%	12%	9%	2.6%	30.3%	21.5%	2.6%
Turkey	1998	2%	2%	2%	2%	0.4%	23.7%	20.2%	0.4%
Ukraine	2002	9%	4%	7%	3%	1.1%	31.3%	14.3%	1.3%
Uruguay	2001	4%	3%	4%	3%	0.7%	26.5%	17.5%	0.7%
Vanuatu	1999	41%	34%	41%	34%	..	..	..	..
Venezuela, Rep. Bol.	2002	11%	5%	11%	5%	1.2%	22.2%	10.7%	1.2%

Source: OECD Secretariat based on IMF Government Finance Statistics and International Finance Statistics. Indicators , customs and import duties data and revenue refers to central government only, the reference period is the latest available year in period 1998-2003.

Annex Table 2a. Simple tariff averages

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	22.3	7.5	8.5	3.8
Low and middle income countries	58.9	22.6	30.7	11.1
of which:				
East Asian & Pacific countries	40.0	14.9	28.8	13.5
Europe	35.0	28.1	10.2	7.0
Latin America and Caribbean	63.4	16.4	39.1	10.4
Middle East and North Africa	59.4	32.1	34.0	21.3
South Asian countries	98.6	24.6	33.7	18.8
Least Developed Countries	77.4	16.6	51.5	13.2

Source : WITS

Annex Table 2b. Trade-weighted averages of MFN applied rates on agricultural products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	5.6	10.1	6.7	11.8	5.1	4.9	2.6	5.9
Least Developed Countries (LDC)	11.5	18.9	13.5	12.5	13.5	16.5	10.3	13.3
Low and middle income countries (LM)	19.6	24.0	28.8	22.5	15.9	18.9	15.5	20.3
of which:								
East Asian & Pacific (LMEAP)	11.9	17.3	17.3	15.4	12.6	16.4	12.6	15.1
Europe (LMEurope)	20.7	18.7	15.8	22.2	24.3	19.5	12.6	20.5
Latin America and Caribbean (LMLAC)	23.2	15.9	11.8	34.2	14.6	13.2	9.3	14.8
Middle East and North Africa (LMMNA)	28.8	19.3	28.3	23.4	11.6	17.6	10.7	17.8
South Asian countries (LMSAsia)	19.9	30.6	69.1	23.4	35.9	21.1	22.6	48.3

Source : WITS

Annex Table 2c. Trade-weighted averages of MFN bound rates on agricultural products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	8.3	14.0	7.2	21.1	6.8	8.7	3.2	7.6
Least Developed Countries (LDC)	66.5	106.1	107.3	72.8	153.1	48.1	149.0	121.3
Low and middle income countries (LM)	39.4	79.2	80.0	37.0	43.7	43.6	68.1	54.6
of which:								
East Asian & Pacific (LMEAP)	25.9	18.4	27.4	30.0	17.3	17.5	27.6	23.1
Europe (LMEurope)	28.0	19.6	23.9	32.2	28.9	26.4	22.4	28.7
Latin America and Caribbean (LMLAC)	45.3	64.2	38.6	32.3	47.7	39.2	35.5	46.8
Middle East and North Africa (LMMNA)	41.0	29.4	27.2	60.6	49.6	23.8	16.4	42.0
South Asian countries (LMSAsia)	79.2	118.0	205.7	86.0	102.5	96.5	132.7	160.2

Source : WITS

Annex Table 2d. Trade-weighted averages of MFN applied rates on industrial products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	2.2	9.8	3.5	3.1	4.0	1.9	6.4	3.7
Least Developed Countries (LDC)	10.8	8.8	17.5	7.5	8.6	8.7	18.7	14.0
Low and middle income countries (LM)	11.0	7.6	10.5	6.4	10.4	6.4	11.4	8.9
of which:								
East Asian & Pacific (LMEAP)	9.6	5.4	8.9	6.2	5.1	6.7	9.0	7.5
Europe (LMEurope)	7.1	6.5	6.6	5.2	4.4	1.0	6.9	5.2
Latin America and Caribbean (LMLAC)	12.8	10.0	12.8	7.6	11.5	2.8	13.0	11.1
Middle East and North Africa (LMMNA)	20.9	18.9	25.9	24.1	21.0	14.7	19.9	20.6
South Asian countries (LMSAsia)	24.3	22.0	19.7	26.7	16.7	17.4	17.8	20.9

Source : WITS

Annex Table 2e. Trade-weighted averages of MFN bound rates on industrial products

	Country source of imports							
	DEV	LDC	LMEAP	LM Europe	LMLAC	LMMNA	LMSAsia	LM
Reporter:								
Developed countries (DEV)	2.9	10.2	3.7	3.5	3.9	3.4	6.6	3.9
Least Developed Countries (LDC)	28.7	20.3	32.9	28.2	29.4	27.0	33.6	31.2
Low and middle income countries (LM)	19.2	7.3	14.9	9.2	27.4	13.3	14.9	16.5
of which:								
East Asian & Pacific (LMEAP)	8.3	1.7	7.7	7.0	5.2	2.6	6.2	6.4
Europe (LMEurope)	9.1	12.3	7.5	6.9	7.2	7.3	11.8	7.1
Latin America and Caribbean (LMLAC)	33.4	32.7	33.2	26.7	31.9	33.2	32.1	32.1
Middle East and North Africa (LMMNA)	28.8	27.8	31.2	30.5	23.0	28.0	22.1	28.4
South Asian countries (LMSAsia)	31.6	33.2	25.3	33.4	33.7	35.2	26.6	30.4

Source : WITS

Annex Table 2f. Differences between bound and applied rates

	Agricultural products		Non-agricultural products	
	absolute	as % of applied rate	absolute	as % of applied rate
Reporter:				
Developed countries (DEV)	14.9	199.3%	4.7	124.1%
Low and middle income economies	36.4	161.3%	19.6	176.4%
of which				
East Asian & Pacific countries	25.1	168.7%	15.3	113.6%
Europe	6.9	24.5%	3.2	45.8%
Latin America and Caribbean	47.0	287.3%	28.7	275.2%
Middle East and North Africa	27.4	85.5%	12.7	59.6%
South Asian countries	74.0	300.1%	14.9	79.5%
Least Developed Countries	60.8	365.6%	38.4	291.0%

Source : WITS

Annex Table 2g. Coefficients of variation

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	2.0	2.9	1.3	1.7
Low and middle income economies	1.0	2.4	0.7	1.1
of which				
East Asian & Pacific countries	1.1	17.7	0.8	1.3
Europe	1.4	1.3	1.0	1.1
Latin America and Caribbean	0.6	1.4	0.4	0.9
Middle East and North Africa	2.7	4.3	0.5	0.9
South Asian countries	0.7	0.9	0.8	0.7
Least Developed Countries	0.7	0.7	0.6	0.8

Source : WITS

Annex Table 2h. Incidence of international tariff peaks (% of total number of lines)

	Agricultural products		Non-agricultural products	
	Bound	Applied	Bound	Applied
Reporter:				
Developed countries (DEV)	21.0%	18.7%	4.8%	8.0%
Low and middle income economies	72.6%	81.0%	24.1%	36.9%
of which				
East Asian & Pacific countries	69.2%	70.2%	25.5%	24.4%
Europe	22.5%	55.1%	9.0%	35.5%
Latin America and Caribbean	94.9%	96.2%	26.5%	33.3%
Middle East and North Africa	86.3%	59.7%	49.8%	47.5%
South Asian countries	86.7%	97.3%	52.5%	59.9%
Least Developed Countries	88.3%	96.7%	35.0%	41.9%

Source : WITS

Annex Table 3. Average import demand elasticity by HS commodity

Commodity	Description	Average import demand elasticity
1	LIVE ANIMALS	0.5
2	MEAT AND EDIBLE MEAT OFFAL	1.1
3	FISH, CRUSTACEANS & AQUATIC INVERTEBRATES	1.1
4	DAIRY PRODS; BIRDS EGGS; HONEY; ED ANIMAL PR NESOI	1.0
5	PRODUCTS OF ANIMAL ORIGIN, NESOI	1.1
6	LIVE TREES, PLANTS, BULBS ETC.; CUT FLOWERS ETC.	0.9
7	EDIBLE VEGETABLES & CERTAIN ROOTS & TUBERS	0.6
8	EDIBLE FRUIT & NUTS; CITRUS FRUIT OR MELON PEEL	0.8
9	COFFEE, TEA, MATE & SPICES	1.2
10	CEREALS	0.6
11	MILLING PRODUCTS; MALT; STARCH; INULIN; WHT GLUTEN	1.1
12	OIL SEEDS ETC.; MISC GRAIN, SEED, FRUIT, PLANT ETC	0.5
13	LAC; GUMS, RESINS & OTHER VEGETABLE SAP & EXTRACT	0.9
14	VEGETABLE PLAITING MATERIALS & PRODUCTS NESOI	0.8
15	ANIMAL OR VEGETABLE FATS, OILS ETC. & WAXES	1.2
16	EDIBLE PREPARATIONS OF MEAT, FISH, CRUSTACEANS ETC	1.1
17	SUGARS AND SUGAR CONFECTIONARY	1.2
18	COCOA AND COCOA PREPARATIONS	1.0
19	PREP CEREAL, FLOUR, STARCH OR MILK; BAKERS WARES	1.1
20	PREP VEGETABLES, FRUIT, NUTS OR OTHER PLANT PARTS	1.1
21	MISCELLANEOUS EDIBLE PREPARATIONS	1.1
22	BEVERAGES, SPIRITS AND VINEGAR	1.2
23	FOOD INDUSTRY RESIDUES & WASTE; PREP ANIMAL FEED	0.9
24	TOBACCO AND MANUFACTURED TOBACCO SUBSTITUTES	0.9
25	SALT; SULFUR; EARTH & STONE; LIME & CEMENT PLASTER	1.3
26	ORES, SLAG AND ASH	1.2
27	MINERAL FUEL, OIL ETC.; BITUMIN SUBST; MINERAL WAX	1.6
28	INORG CHEM; PREC & RARE-EARTH MET & RADIOACT COMPD	1.6
29	ORGANIC CHEMICALS	1.6
30	PHARMACEUTICAL PRODUCTS	1.9
31	FERTILIZERS	1.6
32	TANNING & DYE EXT ETC; DYE, PAINT, PUTTY ETC; INKS	1.7
33	ESSENTIAL OILS ETC; PERFUMERY, COSMETIC ETC PREPS	1.6
34	SOAP ETC; WAXES, POLISH ETC; CANDLES; DENTAL PREPS	1.8
35	ALBUMINOIDAL SUBST; MODIFIED STARCH; GLUE; ENZYMES	1.2
36	EXPLOSIVES; PYROTECHNICS; MATCHES; PYRO ALLOYS ETC	2.4
37	PHOTOGRAPHIC OR CINEMATOGRAPHIC GOODS	1.4
38	MISCELLANEOUS CHEMICAL PRODUCTS	2.2
39	PLASTICS AND ARTICLES THEREOF	2.4
40	RUBBER AND ARTICLES THEREOF	4.8
41	RAW HIDES AND SKINS (NO FURSKINS) AND LEATHER	3.2
42	LEATHER ART; SADDLERY ETC; HANDBAGS ETC; GUT ART	4.0
43	FURSKINS AND ARTIFICIAL FUR; MANUFACTURES THEREOF	2.1
44	WOOD AND ARTICLES OF WOOD; WOOD CHARCOAL	1.6
45	CORK AND ARTICLES OF CORK	1.4
46	MFR OF STRAW, ESPARTO ETC.; BASKETWARE & WICKERWRK	1.3

Annex Table 3. Average import demand elasticity by HS commodity (continued)

Commodity	Description	Average import demand elasticity
47	WOOD PULP ETC; RECOVD (WASTE & SCRAP) PPR & PPRBD	1.4
48	PAPER & PAPERBOARD & ARTICLES (INC PAPR PULP ARTL)	1.4
49	PRINTED BOOKS, NEWSPAPERS ETC; MANUSCRIPTS ETC	1.4
50	SILK, INCLUDING YARNS AND WOVEN FABRIC THEREOF	1.2
51	WOOL & ANIMAL HAIR, INCLUDING YARN & WOVEN FABRIC	1.1
52	COTTON, INCLUDING YARN AND WOVEN FABRIC THEREOF	1.3
53	VEG TEXT FIB NESOI; VEG FIB & PAPER YNS & WOV FAB	0.8
54	MANMADE FILAMENTS, INCLUDING YARNS & WOVEN FABRICS	1.4
55	MANMADE STAPLE FIBERS, INCL YARNS & WOVEN FABRICS	1.4
56	WADDING, FELT ETC; SP YARN; TWINE, ROPES ETC.	1.6
57	CARPETS AND OTHER TEXTILE FLOOR COVERINGS	1.3
58	SPEC WOV FABRICS; TUFTED FAB; LACE; TAPESTRIES ETC	1.3
59	IMPREGNATED ETC TEXT FABRICS; TEX ART FOR INDUSTRY	1.7
60	KNITTED OR CROCHETED FABRICS	3.8
61	APPAREL ARTICLES AND ACCESSORIES, KNIT OR CROCHET	3.8
62	APPAREL ARTICLES AND ACCESSORIES, NOT KNIT ETC.	3.8
63	TEXTILE ART NESOI; NEEDLECRAFT SETS; WORN TEXT ART	1.6
64	FOOTWEAR, GAITERS ETC. AND PARTS THEREOF	4.3
65	HEADGEAR AND PARTS THEREOF	3.8
66	UMBRELLAS, WALKING-STICKS, RIDING-CROPS ETC, PARTS	3.8
67	PREP FEATHERS, DOWN ETC; ARTIF FLOWERS; H HAIR ART	3.8
68	ART OF STONE, PLASTER, CEMENT, ASBESTOS, MICA ETC.	1.6
69	CERAMIC PRODUCTS	2.9
70	GLASS AND GLASSWARE	1.7
71	NAT ETC PEARLS, PREC ETC STONES, PR MET ETC; COIN	2.4
72	IRON AND STEEL	2.0
73	ARTICLES OF IRON OR STEEL	1.7
74	COPPER AND ARTICLES THEREOF	1.1
75	NICKEL AND ARTICLES THEREOF	1.1
76	ALUMINUM AND ARTICLES THEREOF	1.1
78	LEAD AND ARTICLES THEREOF	1.1
79	ZINC AND ARTICLES THEREOF	1.1
80	TIN AND ARTICLES THEREOF	1.1
81	BASE METALS NESOI; CERMETS; ARTICLES THEREOF	1.3
82	TOOLS, CUTLERY ETC. OF BASE METAL & PARTS THEREOF	3.8
83	MISCELLANEOUS ARTICLES OF BASE METAL	3.0
84	NUCLEAR REACTORS, BOILERS, MACHINERY ETC.; PARTS	1.6
85	ELECTRIC MACHINERY ETC; SOUND EQUIP; TV EQUIP; PTS	1.9
86	RAILWAY OR TRAMWAY STOCK ETC; TRAFFIC SIGNAL EQUIP	1.7
87	VEHICLES, EXCEPT RAILWAY OR TRAMWAY, AND PARTS ETC	2.6
88	AIRCRAFT, SPACECRAFT, AND PARTS THEREOF	5.7
89	SHIPS, BOATS AND FLOATING STRUCTURES	1.4
90	OPTIC, PHOTO ETC, MEDIC OR SURGICAL INSTRMENTS ETC	2.2
91	CLOCKS AND WATCHES AND PARTS THEREOF	1.9
92	MUSICAL INSTRUMENTS; PARTS AND ACCESSORIES THEREOF	3.8
93	ARMS AND AMMUNITION; PARTS AND ACCESSORIES THEREOF	1.0
94	FURNITURE; BEDDING ETC; LAMPS NESOI ETC; PREFAB BD	5.0
95	TOYS, GAMES & SPORT EQUIPMENT; PARTS & ACCESSORIES	3.8
96	MISCELLANEOUS MANUFACTURED ARTICLES	2.7
97	WORKS OF ART, COLLECTORS' PIECES AND ANTIQUES	1.1

Source: OECD Secretariat calculations based on WITS

Annex Table 4a. Partial equilibrium simulation: summary of tariff effects of Swiss Formula with coefficient of 5[1]

	Initial average tariff rate				Average tariff rate following cut of applied rates				Average tariff rate following formula cut of bound rates[1]			
	simple		trade-weighted		simple		trade-weighted		simple		trade-weighted	
	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound
Argentina	13.8	31.9	12.4	30.8	3.5	31.9	3.4	30.9	4.2	4.3	4.1	4.3
Bangladesh	20.7	162.2	21.1	20.6	3.5	162.2	3.6	18.6	4.0	4.1	4.0	4.2
Brazil	13.8	31.4	10.0	30.7	3.4	31.4	2.8	30.7	4.1	4.3	3.4	4.2
Chile	7.0	25.1	7.0	25.1	2.9	25.1	2.9	25.1	4.2	4.2	4.2	4.2
China	15.9	10.0	14.1	5.9	3.5	10.0	3.3	6.2	3.0	2.9	2.1	2.1
Colombia	12.3	42.8	11.3	45.3	3.3	42.8	3.2	44.7	4.4	4.4	4.2	4.4
India	32.0	49.3	26.4	28.2	4.2	49.3	4.1	30.3	4.4	4.4	4.1	4.1
Indonesia	6.9	37.5	4.3	37.2	2.3	37.5	1.6	36.4	3.4	4.3	2.3	4.2
Malawi	13.1	75.3	12.4	26.7	3.1	75.3	2.9	24.6	3.8	4.0	3.5	4.0
Malaysia	8.3	14.5	4.8	5.8	1.7	14.5	1.2	6.3	1.9	2.9	1.2	1.8
Morocco	30.6	41.2	27.1	43.8	3.8	41.2	3.9	43.4	4.1	4.4	4.2	4.4
Mozambique	12.1	99.7	9.1	99.8	3.0	99.7	2.9	99.8	4.2	4.8	4.4	4.8
Peru	13.7	30.1	12.8	31.3	3.6	30.1	3.6	31.2	4.3	4.3	4.3	4.3
Philippines	5.7	25.6	3.2	7.8	2.2	25.6	1.4	7.9	3.1	3.7	1.9	2.2
Sri Lanka	9.3	29.7	6.7	10.9	2.6	29.7	1.8	10.9	3.1	3.5	2.2	3.1
Tanzania	16.3	120.0	13.1	18.0	3.5	120.0	3.4	17.6	4.1	4.1	4.0	4.0
Thailand	16.1	25.7	9.3	9.8	3.1	25.7	2.3	10.3	3.5	3.8	2.5	2.7
Madagascar	4.6	27.4	3.2	8.7	1.7	27.4	1.4	8.7	2.3	2.7	1.9	2.6
Uganda	8.9	73.5	7.1	12.0	2.8	73.5	2.5	11.8	3.4	3.5	3.1	3.3
Uruguay	13.8	31.7	12.4	31.1	3.4	31.7	3.2	31.1	4.2	4.3	3.8	4.3
Venezuela	12.4	36.8	13.4	37.8	3.3	36.8	3.4	37.7	4.3	4.4	4.3	4.3
Vietnam	16.5	n/a	17.5	n/a	2.4	n/a	2.9	0.0	2.8	2.8	3.2	3.2
Zambia	12.6	105.7	9.2	20.9	2.8	105.7	2.6	19.2	3.3	3.4	3.2	3.5
Zimbabwe	19.6	92.1	10.4	7.3	3.4	92.1	2.6	7.2	3.9	3.9	2.9	3.0

[1] Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate

Source : OECD Secretariat calculation based on data from WITS

Annex Table 4b. Partial equilibrium simulation: trade, revenue and welfare estimates for Swiss formula with coefficient of 5[1]

	Trade effect (%)		Revenue effect (%)		Net welfare effect (as % of initial value of imports)	
	Applied	Bound[1]	Applied	Bound[1]	Applied	Bound[1]
Argentina	16.2	15.0	-68.3	-62.3	0.8	0.7
Bangladesh	22.8	22.2	-79.3	-76.7	2.3	2.2
Brazil	13.0	12.0	-68.3	-61.8	0.7	0.7
Chile	7.5	5.2	-55.1	-37.2	0.1	0.1
China	14.8	16.9	-72.8	-82.9	0.9	1.1
Colombia	14.0	12.1	-68.0	-58.5	0.8	0.7
India	31.0	31.1	-79.9	-79.6	3.2	3.2
Indonesia	4.8	3.7	-61.0	-44.6	0.2	0.2
Malawi	17.4	16.4	-72.1	-67.0	1.2	1.2
Malaysia	6.3	6.3	-73.9	-73.6	0.6	0.6
Morocco	35.6	35.1	-80.4	-79.2	4.3	4.3
Mozambique	10.5	8.2	-64.5	-47.9	0.6	0.5
Peru	14.8	13.6	-68.0	-61.9	0.6	0.5
Philippines	3.2	2.3	-56.4	-40.9	0.1	0.1
Sri Lanka	6.7	6.1	-70.6	-64.9	0.4	0.4
Tanzania	16.0	15.0	-70.2	-64.8	1.1	1.0
Thailand	12.3	12.0	-72.4	-70.2	1.0	1.0
Madagascar	4.0	3.0	-54.3	-38.5	0.1	0.1
Uganda	8.5	7.5	-62.1	-53.1	0.3	0.3
Uruguay	17.4	16.4	-69.6	-64.5	1.0	0.9
Venezuela	17.7	16.1	-69.7	-62.7	1.1	1.0
Vietnam	22.4	21.8	-80.0	-77.8	2.9	2.9
Zambia	11.5	10.7	-68.6	-61.8	0.7	0.6
Zimbabwe	12.5	12.0	-72.0	-68.6	1.0	1.0

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source OECD Secretariat calculation based on data from WITS

Annex Table 4c. Partial equilibrium simulation: summary of tariff effects of Swiss formula with coefficient of 10[1]

	Initial average tariff rate				Average tariff rate following cut of applied rates				Average tariff rate following formula cut of bound rates[1]			
	simple		trade-weighted		simple		trade-weighted		simple		trade-weighted	
	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound
Argentina	13.8	31.9	12.4	30.8	5.5	31.9	5.3	30.9	7.0	7.5	6.8	7.5
Bangladesh	20.7	162.2	21.1	20.6	5.8	162.2	6.0	18.8	7.1	7.4	7.1	7.6
Brazil	13.8	31.4	10.0	30.7	5.4	31.4	4.3	30.7	6.9	7.5	5.6	7.3
Chile	7.0	25.1	7.0	25.1	4.1	25.1	4.1	25.1	7.0	7.1	7.0	7.1
China	15.9	10.0	14.1	5.9	5.6	10.0	5.2	6.2	4.4	4.4	3.0	3.0
Colombia	12.3	42.8	11.3	45.3	5.1	42.8	4.9	44.8	7.0	7.9	6.7	7.9
India	32.0	49.3	26.4	28.2	7.4	49.3	6.9	30.3	7.9	8.0	7.3	7.4
Indonesia	6.9	37.5	4.3	37.2	3.3	37.5	2.3	36.4	4.8	7.6	3.1	7.5
Malawi	13.1	75.3	12.4	26.7	4.8	75.3	4.7	24.9	6.4	7.1	5.9	7.1
Malaysia	8.3	14.5	4.8	5.8	2.8	14.5	1.8	6.3	3.1	4.5	1.8	2.8
Morocco	30.6	41.2	27.1	43.8	6.6	41.2	6.7	43.4	7.2	8.0	7.2	7.9
Mozambique	12.1	99.7	9.1	99.8	4.6	99.7	4.3	99.8	6.5	9.1	6.5	9.1
Peru	13.7	30.1	12.8	31.3	5.7	30.1	5.6	31.3	7.5	7.5	7.5	7.5
Philippines	5.7	25.6	3.2	7.8	3.1	25.6	1.8	7.9	4.2	6.1	2.5	3.6
Sri Lanka	9.3	29.7	6.7	10.9	3.9	29.7	2.8	10.9	5.1	5.7	3.5	5.0
Tanzania	16.3	120.0	13.1	18.0	5.6	120.0	5.2	17.7	7.1	7.2	6.9	6.9
Thailand	16.1	25.7	9.3	9.8	5.0	25.7	3.6	10.2	5.8	6.6	4.0	4.6
Madagascar	4.6	27.4	3.2	8.7	2.4	27.4	1.9	8.7	3.5	4.5	2.7	4.1
Uganda	8.9	73.5	7.1	12.0	4.2	73.5	3.6	11.8	5.7	5.9	5.0	5.5
Uruguay	13.8	31.7	12.4	31.1	5.4	31.7	5.1	31.1	7.0	7.5	6.4	7.5
Venezuela	12.4	36.8	13.4	37.8	5.2	36.8	5.4	37.8	6.9	7.7	7.1	7.7
Vietnam	16.5	n/a	17.5	n/a	4.1	n/a	4.8	0.0	4.8	4.9	5.6	5.7
Zambia	12.6	105.7	9.2	20.9	4.6	105.7	4.0	19.4	5.8	6.0	5.2	6.1
Zimbabwe	19.6	92.1	10.4	7.3	5.6	92.1	4.1	7.3	6.8	6.8	4.8	5.0

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : OECD Secretariat calculation based on data from WITS

Annex Table 4d. Partial equilibrium simulation: trade, revenue and welfare estimates for Swiss formula with coefficient of 10[1]

	Trade effect (%)		Revenue effect (%)		Net welfare effect (as % of initial value of imports)	
	Applied	Bound[1]	Applied	Bound[1]	Applied	Bound[1]
Argentina	12.9	10.2	-52.0	-39.3	0.5	0.4
Bangladesh	19.8	18.2	-66.1	-60.1	1.8	1.6
Brazil	10.4	8.3	-52.2	-39.5	0.5	0.4
Chile	5.3	0.0	-38.0	0.0	0.1	0.0
China	11.9	15.5	-58.6	-75.8	0.7	1.0
Colombia	11.2	8.1	-52.1	-35.7	0.6	0.4
India	27.1	26.9	-66.6	-65.1	2.5	2.5
Indonesia	3.7	2.2	-45.2	-25.6	0.2	0.1
Malawi	14.5	12.3	-56.7	-46.1	0.9	0.7
Malaysia	5.3	5.4	-59.7	-59.5	0.5	0.5
Morocco	31.5	30.4	-67.4	-65.2	3.5	3.4
Mozambique	8.3	4.7	-48.7	-25.3	0.4	0.3
Peru	11.5	8.3	-51.5	-36.2	0.4	0.2
Philippines	2.4	1.3	-41.5	-23.3	0.1	0.1
Sri Lanka	5.4	4.1	-56.0	-44.5	0.3	0.2
Tanzania	13.1	10.7	-54.7	-41.8	0.7	0.6
Thailand	10.3	9.6	-57.5	-52.8	0.8	0.7
Madagascar	2.9	1.2	-37.7	-13.4	0.1	0.0
Uganda	6.5	4.1	-45.4	-26.0	0.2	0.1
Uruguay	14.1	11.8	-53.4	-42.4	0.7	0.6
Venezuela	14.4	11.5	-53.9	-40.8	0.8	0.7
Vietnam	19.8	18.4	-67.3	-62.1	2.4	2.3
Zambia	9.3	7.5	-52.7	-39.2	0.5	0.4
Zimbabwe	10.4	9.2	-56.9	-49.5	0.7	0.7

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : OECD Secretariat calculation based on data from WITS

Annex Table 4e. Partial equilibrium simulation: summary of tariff effects of Swiss formula with coefficient of 15[1]

	Initial average tariff rate				Average tariff rate following cut of applied rates				Average tariff rate following formula cut of bound rates[1]			
	simple		trade-weighted		simple		trade-weighted		simple		trade-weighted	
	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound	applied	bound
Argentina	13.8	31.9	12.4	30.8	5.5	31.9	5.3	30.9	7.0	7.5	6.8	7.5
Bangladesh	20.7	162.2	21.1	20.6	5.8	162.2	6.0	18.8	7.1	7.4	7.1	7.6
Brazil	13.8	31.4	10.0	30.7	5.4	31.4	4.3	30.7	6.9	7.5	5.6	7.3
Chile	7.0	25.1	7.0	25.1	4.1	25.1	4.1	25.1	7.0	7.1	7.0	7.1
China	15.9	10.0	14.1	5.9	5.6	10.0	5.2	6.2	4.4	4.4	3.0	3.0
Colombia	12.3	42.8	11.3	45.3	5.1	42.8	4.9	44.8	7.0	7.9	6.7	7.9
India	32.0	49.3	26.4	28.2	7.4	49.3	6.9	30.3	7.9	8.0	7.3	7.4
Indonesia	6.9	37.5	4.3	37.2	3.3	37.5	2.3	36.4	4.8	7.6	3.1	7.5
Malawi	13.1	75.3	12.4	26.7	4.8	75.3	4.7	24.9	6.4	7.1	5.9	7.1
Malaysia	8.3	14.5	4.8	5.8	2.8	14.5	1.8	6.3	3.1	4.5	1.8	2.8
Morocco	30.6	41.2	27.1	43.8	6.6	41.2	6.7	43.4	7.2	8.0	7.2	7.9
Mozambique	12.1	99.7	9.1	99.8	4.6	99.7	4.3	99.8	6.5	9.1	6.5	9.1
Peru	13.7	30.1	12.8	31.3	5.7	30.1	5.6	31.3	7.5	7.5	7.5	7.5
Philippines	5.7	25.6	3.2	7.8	3.1	25.6	1.8	7.9	4.2	6.1	2.5	3.6
Sri Lanka	9.3	29.7	6.7	10.9	3.9	29.7	2.8	10.9	5.1	5.7	3.5	5.0
Tanzania	16.3	120.0	13.1	18.0	5.6	120.0	5.2	17.7	7.1	7.2	6.9	6.9
Thailand	16.1	25.7	9.3	9.8	5.0	25.7	3.6	10.2	5.8	6.6	4.0	4.6
Madagascar	4.6	27.4	3.2	8.7	2.4	27.4	1.9	8.7	3.5	4.5	2.7	4.1
Uganda	8.9	73.5	7.1	12.0	4.2	73.5	3.6	11.8	5.7	5.9	5.0	5.5
Uruguay	13.8	31.7	12.4	31.1	5.4	31.7	5.1	31.1	7.0	7.5	6.4	7.5
Venezuela	12.4	36.8	13.4	37.8	5.2	36.8	5.4	37.8	6.9	7.7	7.1	7.7
Vietnam	16.5	n/a	17.5	n/a	4.1	n/a	4.8	0.0	4.8	4.9	5.6	5.7
Zambia	12.6	105.7	9.2	20.9	4.6	105.7	4.0	19.4	5.8	6.0	5.2	6.1
Zimbabwe	19.6	92.1	10.4	7.3	5.6	92.1	4.1	7.3	6.8	6.8	4.8	5.0

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates falls below the level of initial applied rate.

Source : OECD Secretariat calculation based on data from WITS

Annex Table 4f. Partial equilibrium simulation: trade, revenue and welfare estimates for Swiss formulat with coefficient 15[1]

	Trade effect (%)		Revenue effect (%)		Net welfare effect (as % of initial value of imports)	
	Applied	Bound[1]	Applied	Bound[1]	Applied	Bound[1]
Argentina	10.8	6.8	-41.9	-24.6	0.4	0.2
Bangladesh	17.6	15.1	-56.7	-47.8	1.4	1.2
Brazil	8.7	5.9	-42.2	-25.9	0.4	0.2
Chile	4.1	0.0	-29.0	0.0	0.0	0.0
China	10.0	14.7	-49.6	-71.7	0.5	0.9
Colombia	9.4	5.6	-42.3	-22.3	0.4	0.3
India	24.1	23.5	-57.1	-54.2	2.0	2.0
Indonesia	3.0	1.5	-36.2	-16.3	0.1	0.1
Malawi	12.4	9.4	-46.7	-32.5	0.7	0.5
Malaysia	4.7	4.7	-50.3	-50.3	0.4	0.4
Morocco	28.4	26.8	-57.9	-54.8	2.9	2.8
Mozambique	7.0	3.3	-39.2	-16.6	0.3	0.2
Peru	9.5	4.1	-41.4	-18.0	0.3	0.1
Philippines	1.9	0.9	-33.4	-16.6	0.1	0.0
Sri Lanka	4.5	2.9	-46.8	-32.8	0.2	0.1
Tanzania	11.2	7.9	-44.8	-27.6	0.6	0.4
Thailand	9.0	7.9	-47.7	-41.0	0.6	0.6
Madagascar	2.3	0.6	-28.9	-6.7	0.0	0.0
Uganda	5.2	2.1	-35.7	-11.7	0.1	0.0
Uruguay	11.9	8.7	-43.2	-28.7	0.5	0.3
Venezuela	12.2	8.4	-43.9	-26.9	0.6	0.4
Vietnam	17.9	15.8	-58.1	-50.4	2.1	1.9
Zambia	7.8	5.2	-42.7	-24.9	0.3	0.2
Zimbabwe	9.0	7.3	-47.2	-37.4	0.6	0.6

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : OECD Secretariat calculation based on data from WITS

Annex Table 5. Regional aggregations for the general equilibrium simulation

Country group or country	Original GTAP regions
Argentina	Argentina
Bangladesh	Bangladesh
Brazil	Brazil
Chile	Chile
China	China
Colombia	Colombia
European Union and EFTA	Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Rest of EFTA, Spain, Sweden, Switzerland, United Kingdom
Indonesia	Indonesia
India	India
Sri Lanka	Sri Lanka
Morocco	Morocco
Madagascar	Madagascar
Rest of Middle East, Rest of North Africa	Rest of Middle East, Rest of North Africa
Mozambique	Mozambique
Malawi	Malawi
Malaysia	Malaysia
North America and Mexico	Canada, Mexico, Rest of North America, United States
North and East Asia	Hong Kong, Japan, Korea, Rest of East Asia, Taiwan
Oceania	Australia, New Zealand, Rest of Oceania
Peru	Peru
Philippines	Philippines
Rest of Europe	Albania, Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Rest of Europe, Romania, Slovakia, Slovenia
Rest of World	Central America, Rest of Former Soviet Union, Rest of FTAA, Rest of South Asia, Rest of the Caribbean, Russian Federation
Rest of Latin America	Rest of Andean Pact, Rest of South America
Singapore	Singapore
Rest of Sub-Saharan Africa	Botswana, Rest of SADC, Rest of South African Customs Union, Rest of Sub Saharan Africa, South Africa
Thailand	Thailand
Turkey	Turkey
Tanzania	Tanzania
Uganda	Uganda
Uruguay	Uruguay
Venezuela	Venezuela
Vietnam	Vietnam
Rest of Southeast Asia	Rest of Southeast Asia
Zambia	Zambia
Zimbabwe	Zimbabwe

Annex Table 6. Sectoral aggregations for the general equilibrium simulation

Sectors	Original GTAP sectors
Natural resources	Forestry, Coal, Oil and Gas, Minerals nec
Primary agriculture	Paddy rice, Wheat , Cereal grains nec, Vegetables, fruit, nuts, Oil seeds, Sugar cane, sugar beet, Crops nec, Bovine cattle, sheep and goats, horses, Animal products nec, Raw milk, Wool, silk-worm cocoons Fishing, Bovine meat products, Meat products nec
Processed agriculture	Plant-based fibres, Meat products nec, Vegetable oils and fats , Dairy products, Processed rice, Sugar, Food products nec Beverages and tobacco products
Textiles, apparel and leather	Textiles, Wearing apparel, Leather products
Chemical, rubber and plastic products	Chemical, rubber, plastic prods
Wood products	Wood products
Motor vehicles and parts	Motor vehicles and parts
Other machinery and equipment	Machinery and equipment nec
Other manufacturing (not classified elsewhere)	Paper products, publishing, Petroleum, coal products, Mineral products nec, Ferrous metals, Metals nec, Metal products, Transport equipment nec, Electronic equipment, Manufactures nec
Services	Electricity, Gas manufacture, distribution, Water, Construction, Trade, Transport nec, Water transport Air transport, Communication, Financial services nec, Insurance, Business services nec Recreational and other services, Public Administration, Defence, Education, Health Dwellings

Annex Table 7. General equilibrium simulation

Summary of welfare change estimates for all regions (equivalent variation, US$ million)

Region	Tariff cut scenario[1]		
	Swiss5	Swiss10	Swiss15
Oceania	3218	2790	2553
China	3753.4	2305.6	1509.1
North and East Asia	13923	11858	10596
Indonesia	842	676	560
Malaysia	1262	1008	850
Philippines	153	99	68
Singapore	878	678	566
Thailand	1810	1476	1247
Vietnam	542	454	376
Rest of Southeast Asia	17	27	26
Bangladesh	131	120	94
India	1982	1937	1832
Sri Lanka	158	100	63
Rest of World	1432	1191	987
North America	1162	1038	915
Colombia	-153	-38	-4
Peru	86	66	43
Venezuela	38	32	-9
Rest of Latin America	130	90	71
Argentina	2050	1349	994
Brazil	1264	1188	1037
Chile	-17	-31	-44
Uruguay	158	110	93
European Union	5547	3972	3261
Rest of Europe	863	456	373
Turkey	491	300	211
Rest of Middle East and North Africa	715	600	391
Morocco	197	241	257
Rest of Sub-Saharan Africa	1325	1226	1163
Zambia	25	22	19
Zimbabwe	61	53	48

Source : GTAP simulation

Annex Table 8. General equilibrium simulation

Summary of initial tariff profiles of selected developing countries

Region	Trade-weighted tariff		Trade weighted import demand elasticity
	Applied	Bound	
Argentina	7.3	32.2	3.1
Bangladesh	27.4	158.3	3.7
Brazil	8.9	34.3	3.3
Chile	6.6	25.1	3.3
China	9.2	6.9	3.6
Colombia	8.2	57.3	3.6
India	31.1	46.2	3.5
Indonesia	4.6	38.2	3.7
Madagascar	3.8	26.3	3.2
Malawi	10.5	105.9	2.8
Malaysia	5.0	6.7	3.5
Morocco	29.1	48.9	3.4
Mozambique	8.9	99.9	3.3
Peru	12.4	32.4	3.4
Philippines	2.8	11.1	3.5
Sri Lanka	7.3	20.4	3.5
Tanzania	14.8	84.2	3.1
Thailand	15.8	19.0	3.4
Uganda	6.1	66.5	2.9
Uruguay	5.5	32.0	3.0
Venezuela	6.7	33.7	4.1
Vietnam	17.8	43.5	3.5
Zambia	9.3	42.7	3.4
Zimbabwe	30.8	75.9	3.0

Source : GTAP database for applied rates, WITS for bound rates, and GTAP for import demand elasticity

Annex Table 9. General equilibrium simulation: comparison of welfare and revenue changes following tariff liberalisation according to Swiss formula with coefficients of 5, 10 and 15[1]

	Welfare gains US$ million			Per capita welfare gains relative to base %			Revenue impact %		
	Swiss5	Swiss10	Swiss15	Swiss5	swiss10	Swiss 15	Swiss5	Swiss10	Swiss15
Argentina	2049.9	1349.3	994.0	0.84	0.56	0.41	-44.8	-15.3	-4.2
Bangladesh	131.4	119.8	94.2	0.31	0.28	0.22	-66.0	-42.0	-24.9
Brazil	1264.0	1188.0	1037.0	0.28	0.27	0.23	-53.1	-24.4	-10.4
Chile	-17.0	-30.6	-44.4	-0.03	-0.05	-0.07	-35.0	-0.6	-0.6
China	3753.4	2305.6	1509.1	0.36	0.22	0.14	-60.5	-47.1	-40.2
Colombia	-152.9	-37.5	-4.0	-0.2	-0.05	-0.01	-44.3	-11.3	-3.7
India	1982.1	1936.5	1832.1	0.45	0.44	0.42	-74.6	-58.7	-47.7
Indonesia	842.15	676.25	559.86	0.63	0.51	0.42	-26.0	-12.6	-9.4
Madagascar	7.4	4.5	2.6	0.18	0.11	0.06	-14.8	-4.5	-2.7
Malawi	17.5	10.2	6.5	1.12	0.66	0.42	-46.6	-16.6	-5.5
Malaysia	1262.48	1007.88	849.59	1.62	1.29	1.09	-58.1	-42.6	-36.4
Morocco	196.8	240.7	257.3	0.64	0.79	0.84	-73.6	-55.4	-42.1
Mozambique	4.2	6.8	7.6	0.13	0.21	0.23	-41.5	-11.8	-3.5
Peru	85.9	65.6	42.8	0.18	0.14	0.09	-57.5	-30.0	-11.1
Philippines	152.8	99.0	67.7	0.24	0.16	0.11	-21.4	-8.0	-1.0
Sri Lanka	158.2	100.1	63.4	1.12	0.71	0.45	-50.5	-27.1	-15.2
Tanzania	-55.0	-26.7	-9.8	-0.63	-0.3	-0.11	-63.5	-37.0	-19.5
Thailand	1810.1	1475.8	1247.2	1.82	1.48	1.25	-65.6	-47.0	-35.1
Uganda	-19.2	-10.5	-7.0	-0.36	-0.2	-0.13	-33.3	-10.8	-1.7
Uruguay	158.1	110.3	92.9	0.91	0.64	0.53	-26.9	-1.8	1.4
Venezuela	38.2	32.0	-8.8	0.03	0.03	-0.01	-52.4	-19.5	-3.2
Vietnam	542.4	453.6	376.2	1.86	1.56	1.29	-57.7	-34.1	-19.9
Zambia	25.3	21.8	19.3	0.77	0.67	0.59	-43.8	-17.5	-6.5
Zimbabwe	61.4	52.8	48.3	0.77	0.67	0.61	-63.9	-43.6	-31.5
World	44000	35378	30146						

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

*Source :*GTAP model simulations using GTAP and WITS data.

Annex Table 10. General equilibrium simulation comparison of changes of imports and exports following tariff liberalisation according to Swiss formula with coefficients of 5, 10 and 15[1]

	Volume of imports			Volume of exports		
	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15
Argentina	13.5	2.9	1.7	6.33	2.86	1.74
Bangladesh	25.4	16.1	10.9	23	16.07	10.85
Brazil	9.4	2.8	1.3	6.14	2.77	1.27
Chile	2.3	-0.2	-0.2	2.16	-0.18	-0.19
China	13.1	10.2	8.6	13.22	10.15	8.55
Colombia	2.5	0.8	0.4	3.3	0.81	0.44
India	38.5	29.9	24.9	37.16	29.92	24.9
Indonesia	3.71	0.87	0.59	1.98	0.87	0.59
Madagascar	0.7	0.5	0.5	0.85	0.54	0.49
Malawi	9.7	0.8	-0.1	2.8	0.79	-0.09
Malaysia	4.4	1.32	1.06	2.09	1.32	1.06
Morocco	26.8	25.0	19.9	31.75	24.95	19.89
Mozambique	3.1	1.6	0.4	3.89	1.55	0.36
Peru	10.3	6.5	3.0	11.38	6.45	3.04
Philippines	1.0	0.3	0.0	0.82	0.26	-0.02
Sri Lanka	7.2	2.3	1.8	3.2	2.33	1.77
Tanzania	7.1	9.2	5.1	15.34	9.21	5.12
Thailand	12.5	4.9	3.6	7.01	4.91	3.6
Uganda	-0.1	1.4	0.3	3.48	1.44	0.29
Uruguay	3.4	-0.2	-0.1	0.51	-0.19	-0.11
Venezuela	3.6	1.0	0.4	2.5	1	0.38
Vietnam	14.1	6.8	4.1	10.81	6.79	4.13
Zambia	7.0	1.6	0.4	3.81	1.55	0.42
Zimbabwe	14.3	5.5	3.5	8.41	5.46	3.46

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : GTAP model simulations using GTAP and WITS data.

Annex Table 11. Comparison of estimates from partial and general equilibrium simulations following tariff liberalisation according to Swiss Formula with coefficient of 10[1]

Impact on revenue (%)				Impact on welfare (US$ millions)			
general equilibrium		partial equilibrium		general equilibrium		partial equilibrium	
Chile	-0.6	Chile	0.0	Colombia	-37.5	Chile	0.0
Uruguay	-1.8	Madagascar	-13.4	Chile	-30.6	Madagascar	0.2
Madagascar	-4.5	Philippines	-23.3	Tanzania	-26.7	Uganda	1.2
Philippines	-8.0	Mozambique	-25.3	Uganda	-10.5	Malawi	2.7
Uganda	-10.8	Indonesia	-25.6	Madagascar	4.5	Mozambique	3.5
Colombia	-11.3	Uganda	-26.0	Mozambique	6.8	Zambia	4.4
Mozambique	-11.8	Colombia	-35.7	Malawi	10.2	Tanzania	9.6
Indonesia	-12.6	Peru	-36.2	Zambia	21.8	Sri Lanka	12.1
Argentina	-15.3	Zambia	-39.2	Venezuela	32.0	Zimbabwe	12.2
Malawi	-16.6	Argentina	-39.3	Zimbabwe	52.8	Peru	15.6
Zambia	-17.5	Brazil	-39.5	Peru	65.6	Uruguay	17.0
Venezuela	-19.5	Venezuela	-40.8	Philippines	99.0	Philippines	21.9
Brazil	-24.4	Tanzania	-41.8	Sri Lanka	100.1	Argentina	28.1
Sri Lanka	-27.1	Uruguay	-42.4	Uruguay	110.3	Indonesia	38.8
Peru	-30.0	Sri Lanka	-44.5	Bangladesh	119.8	Colombia	55.2
Vietnam	-34.1	Malawi	-46.1	Morocco	240.7	Bangladesh	72.1
Tanzania	-37.0	Zimbabwe	-49.5	Vietnam	453.6	Venezuela	94.8
Bangladesh	-42.0	Thailand	-52.8	Indonesia	676.3	Brazil	193.4
Malaysia	-42.6	Malaysia	-59.5	Malaysia	1007.9	Morocco	326.7
Zimbabwe	-43.6	Bangladesh	-60.1	Brazil	1188.0	Vietnam	332.6
Thailand	-47.0	Vietnam	-62.1	Argentina	1349.3	Malaysia	365.6
China	-47.1	India	-65.1	Thailand	1475.8	Thailand	451.1
Morocco	-55.4	Morocco	-65.2	India	1936.5	India	1290.1
India	-58.7	China	-75.8	China	2305.6	China	2256.8

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : GTAP model simulations using GTAP and WITS data.

Annex Table 12. Tariff liberalisation in agricultural and industrial products – selected sample of developing countries

	Revenue impact		Welfare gains US$ million		Per capita welfare gains relative to base	
	Agriculture	Manufacturing	Agriculture	Manufacturing	Agriculture	Manufacturing
Argentina	5.6%	-19.9%	1282.81	59.77	0.53	0.02
Bangladesh	-3.8%	-38.2%	-6.31	126.49	-0.01	0.30
Brazil	2.7%	-26.3%	1167.11	52.25	0.26	0.01
Chile	-0.6%	0.0%	-60.01	28.82	-0.10	0.05
China	-1.7%	-45.2%	328.81	2007.43	0.03	0.19
Colombia	-0.9%	-10.3%	0.66	-38.25	0.00	-0.05
India	-8.1%	-51.5%	727.4	1173.2	0.17	0.27
Indonesia	-0.3%	-12.3%	80.7	601.37	0.06	0.45
Madagascar	-0.4%	-4.2%	3.16	1.39	0.08	0.03
Malawi	-2.2%	-14.4%	1.84	8.5	0.12	0.55
Malaysia	-5.4%	-37.2%	398.37	615.2	0.51	0.79
Morocco	-11.8%	-43.9%	30.79	205.5	0.10	0.67
Mozambique	-7.7%	-4.2%	-0.47	7.28	-0.01	0.22
Peru	-7.8%	-22.2%	24.83	40.57	0.05	0.08
Philippines	-5.0%	-3.0%	37.34	63.37	0.06	0.10
Sri Lanka	-17.0%	-9.8%	12.69	88.34	0.09	0.62
Tanzania	-10.9%	-26.4%	-1.04	-26.19	-0.01	-0.30
Thailand	-15.1%	-31.7%	719.49	764.76	0.72	0.77
Uganda	-5.5%	-5.2%	-12.46	2.05	-0.24	0.04
Uruguay	5.2%	-6.8%	106.19	4.4	0.61	0.03
Venezuela	-3.1%	-16.5%	-4.25	34.16	0.00	0.03
Vietnam	-11.8%	-21.8%	72.49	378.97	0.25	1.30
Zambia	-4.2%	-13.3%	2.13	19.66	0.07	0.60
Zimbabwe	-10.1%	-33.5%	6.17	46.17	0.08	0.58

Source: GTAP simulations using GTAP and WITS data.

Annex Table 13. Tariff liberalisation in agricultural and industrial products – full sample

	Agriculture			Manufacturing		
	Revenue impact (%)	Welfare (US$ million)	Per capita welfare gain relative to base (%)	Revenue impact (%)	Welfare (US$ million)	Per capita welfare gain relative to base (%)
Oceania	-7%	1297	0.34	-38%	1519	0.40
China	-2%	329	0.03	-45%	2007	0.19
North and East Asia	-37%	8945	0.20	-10%	2882	0.07
Indonesia	0%	81	0.06	-12%	601	0.45
Malaysia	-5%	398	0.51	-37%	615	0.79
Philippines	-5%	37	0.06	-3%	63	0.10
Singapore	7%	245	0.33	1%	433	0.58
Thailand	-15%	719	0.72	-32%	765	0.77
Vietnam	-12%	72	0.25	-22%	379	1.30
Rest of Southeast Asia	-14%	-8	-0.01	-14%	36	0.05
Bangladesh	-4%	-6	-0.01	-38%	126	0.30
India	-8%	727	0.17	-51%	1173	0.27
Sri Lanka	-17%	13	0.09	-10%	88	0.62
Rest of World	-13%	742	0.12	-12%	445	0.07
North America	-9%	821	0.01	-9%	202	0.00
Colombia	-1%	1	0.00	-10%	-38	-0.05
Peru	-8%	25	0.05	-22%	41	0.08
Venezuela	-3%	-4	0.00	-16%	34	0.03
Rest of Latin America	1%	77	0.24	-3%	12	0.04
Argentina	6%	1283	0.53	-20%	60	0.02
Brazil	3%	1167	0.26	-26%	52	0.01
Chile	-1%	-60	-0.10	0%	29	0.05
Uruguay	5%	106	0.61	-7%	4	0.03
European Union	-9%	975	0.01	1%	2995	0.04
Rest of Europe	-17%	477	0.12	0%	-21	-0.01
Turkey	-17%	193	0.15	1%	109	0.08
Rest of Middle East and North Africa	-5%	9	0.00	-11%	578	0.08
Morocco	-12%	31	0.10	-44%	206	0.67
Rest of Sub-Saharan Africa	-9%	303	0.12	-62%	906	0.36
Zambia	-4%	2	0.07	-13%	20	0.60
Zimbabwe	-10%	6	0.08	-34%	46	0.58
Uganda	-6%	-12	-0.24	-5%	2	0.04
Malawi	-2%	2	0.12	-14%	9	0.55
Mozambique	-8%	0	-0.01	-4%	7	0.22
Tanzania	-11%	-1	-0.01	-26%	-26	-0.30
Madagascar	0%	3	0.08	-4%	1	0.03
Total	-7%	18997	0.14	-18%	16360	0.25
Developing	-5%	6288	0.14	-20%	8675	0.28
Developed	-18%	12710	0.17	-12%	7685	0.13

Source: GTAP simulations using GTAP and WITS data.

Annex Table 14. Average trade weighted tariffs by sector (%)

	Natural resources	Primary agriculture	Processed agriculture	Textiles, apparel and leather	Chemical, rubber and plastic products	Wood products	Motor vehicles and parts	Other machinery and equipment	Other manufacturing	Services
Oceania	39.3	3.8	16.2	12.6	3.3	4.6	16.3	3.3	2.8	39.3
China	0.6	6.9	13.8	15.1	8.1	8.3	27.1	8.4	5.3	0.6
North and East Asia	1.2	39.5	29.9	13.5	3.2	2.1	5.4	2.2	1.4	1.2
Indonesia	0.4	2.6	9.6	7.4	5.2	3.1	23.0	3.7	4.4	0.4
Malaysia	1.0	18.6	8.9	11.3	5.9	2.0	76.8	8.4	3.3	1.0
Philippines	3.0	9.9	11.1	6.3	4.1	8.0	11.2	2.5	1.3	3.0
Singapore	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Thailand	0.4	28.1	44.1	17.6	11.5	14.4	42.9	8.2	8.1	0.4
Vietnam	1.7	31.1	41.3	16.6	10.6	11.9	38.7	8.0	8.0	1.7
Rest of Southeast Asia	1.3	8.9	19.7	10.6	5.0	10.4	33.9	5.4	6.2	1.3
Bangladesh	0.8	10.3	18.1	28.9	15.3	22.1	20.8	11.8	18.3	0.8
India	16.8	33.4	57.8	32.0	30.8	31.5	48.7	26.8	25.8	16.8
Sri Lanka	0.3	19.8	22.8	2.9	6.5	7.3	10.9	6.0	8.5	0.3
Rest of World	0.8	13.3	18.8	13.2	6.7	13.5	12.1	6.4	8.1	0.8
North America	0.1	9.0	10.6	9.6	2.6	0.9	1.3	1.6	1.6	0.1
Colombia	4.4	11.0	9.0	14.8	7.1	11.9	13.2	9.0	6.6	4.4
Peru	10.0	16.4	14.0	16.9	10.4	10.8	11.9	12.0	10.7	10.0
Venezuela	4.2	10.5	12.3	12.6	7.9	11.7	12.2	9.3	9.4	4.2
Rest of Latin America	1.5	8.9	8.5	9.1	5.3	8.9	9.2	6.2	6.0	1.5
Argentina	0.3	5.3	7.6	10.0	8.4	7.3	15.4	12.6	7.5	0.3
Brazil	0.3	2.6	9.0	14.1	8.1	11.9	21.3	12.4	8.9	0.3
Chile	6.9	7.0	6.8	6.7	6.5	6.8	6.8	6.9	6.2	6.9
Uruguay	0.1	1.9	5.4	8.2	6.4	4.7	13.0	7.9	5.2	0.1
European Union	0.0	6.8	5.0	2.0	0.7	0.2	1.0	0.4	0.6	0.0
Rest of Europe	3.8	19.0	21.2	5.3	2.2	3.1	5.3	2.2	2.5	3.8
Turkey	0.0	23.3	18.7	4.6	1.1	0.4	0.9	0.5	2.3	0.0
Rest of Middle East and North Africa	2.7	11.5	13.8	12.9	6.9	8.4	13.5	7.7	6.3	2.7
Morocco	10.4	29.6	38.3	37.7	19.6	40.3	26.6	16.6	14.4	10.4
Rest of Sub-Saharan Africa	2.8	11.6	19.7	31.8	13.9	23.7	22.7	14.3	15.5	2.8
Zambia	0.9	6.6	16.6	17.1	5.1	18.8	15.8	5.9	8.9	0.9
Zimbabwe	7.8	44.1	42.1	19.5	10.6	23.7	31.4	11.5	10.2	7.8
Uganda	0.8	4.7	12.8	10.9	5.4	12.6	10.4	1.8	5.5	0.8
Malawi	1.1	9.3	13.5	17.0	5.7	18.7	16.5	7.7	9.3	1.1
Mozambique	1.3	10.2	14.3	17.3	5.0	13.6	8.3	6.5	7.5	1.3
Tanzania	1.5	14.0	21.7	17.7	8.5	20.6	12.7	11.8	15.0	1.5
Madagascar	0.0	3.8	6.0	3.2	1.1	6.0	8.6	4.1	2.5	0.0

Source: GTAP database

Annex Table 15. Sector shares in total imports at world prices (%)

	Natural resources	Primary agriculture	Processed agriculture	Textiles, apparel and leather	Chemical, rubber and plastic products	Wood products	Motor vehicles and parts	Other machinery and equipment	Other manufacturing	Services
Oceania	3	2	4	4	12	1	8	18	27	22
China	4	3	2	6	13	0	2	19	36	14
North and East Asia	10	4	4	6	8	1	2	13	30	23
Indonesia	3	2	4	5	13	0	4	16	24	30
Malaysia	1	2	3	2	7	0	2	16	52	16
Philippines	5	2	4	3	6	0	2	11	43	25
Singapore	5	1	2	2	7	0	2	17	51	12
Thailand	6	1	4	2	11	0	4	16	38	16
Vietnam	0	1	7	8	15	0	3	18	35	13
Rest of Southeast Asia	0	1	8	8	7	0	2	10	19	44
Bangladesh	2	5	8	16	12	0	2	16	25	14
India	11	2	4	2	11	0	2	14	32	22
Sri Lanka	4	4	7	21	11	0	2	13	24	14
Rest of World	8	4	6	8	10	1	4	14	26	20
North America	5	2	3	7	9	1	12	17	30	14
Colombia	0	5	5	4	18	0	5	16	24	24
Peru	7	6	7	3	15	0	4	16	21	21
Venezuela	0	3	7	5	13	1	11	21	20	20
Rest of Latin America	0	4	7	4	18	0	7	19	27	13
Argentina	2	2	3	4	18	1	7	18	22	23
Brazil	6	3	2	2	15	0	5	19	24	24
Chile	7	3	4	6	13	1	6	19	25	18
Uruguay	4	6	6	7	19	1	5	14	19	20
European Union	4	3	4	6	12	1	8	15	29	19
Rest of Europe	6	3	4	8	13	1	8	19	28	12
Turkey	9	2	2	6	14	0	4	18	28	18
Rest of Middle East and North Africa	2	5	5	6	8	1	7	18	25	25
Morocco	7	7	5	19	10	0	5	15	22	10
Rest of Sub-Saharan Africa	3	3	7	5	10	1	7	16	28	20
Zambia	6	3	6	3	15	1	7	21	27	11
Zimbabwe	1	2	2	3	12	0	4	10	32	35
Uganda	2	3	6	3	10	0	4	10	26	36
Malawi	1	5	6	6	16	0	7	15	30	15
Mozambique	0	5	11	3	12	1	4	17	30	16
Tanzania	3	4	9	5	10	0	6	17	20	27
Madagascar	2	2	8	18	8	0	4	12	25	22

Source: GTAP database

Annex Table 16. Swiss and linear formulas compared

	Swiss 10			Flexible Swiss 10 b= 0.5			Flexible Swiss 10 b= 1.5			Linear 40% cut			Linear 50% cut		
	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]
Oceania	-46%	2790	0.74	-41%	2391	0.63	-50%	3069	0.81	-28%	1808	0.48	-37%	2277	0.60
China	-47%	2305.6	0.22	-28%	1884	0.18	-58%	2708	0.26	-32%	3438	0.33	-42%	4314	0.41
North and East Asia	-46%	11858	0.27	-40%	10691	0.24	-51%	12613	0.29	-28%	9576	0.22	-37%	11950	0.27
Indonesia	-13%	676	0.51	-12%	551	0.41	-14%	765	0.58	-35%	532	0.40	-45%	675	0.51
Malaysia	-43%	1008	1.29	-34%	881	1.13	-54%	1121	1.44	-34%	887	1.14	-43%	1103	1.42
Philippines	-8%	99	0.16	-5%	76	0.12	-10%	108	0.17	-36%	126	0.20	-46%	152	0.24
Singapore	8%	678	0.9	7%	553	0.74	9%	757	1.01	-35%	529	0.71	-45%	672	0.90
Thailand	-47%	1476	1.48	-36%	1222	1.23	-54%	1642	1.65	-32%	1319	1.33	-41%	1611	1.62
Vietnam	-34%	454	1.56	-25%	402	1.38	-41%	487	1.67	-29%	383	1.31	-38%	477	1.64
Rest of Southeast Asia	-28%	27	0.04	-22%	16	0.02	-34%	32	0.04	-30%	28	0.04	-39%	30	0.04
Bangladesh	-42%	120	0.28	-39%	102	0.24	-45%	129	0.31	-30%	74	0.17	-39%	83	0.20
India	-59%	1937	0.44	-54%	1875	0.43	-62%	1967	0.45	-24%	1806	0.41	-33%	2178	0.50
Sri Lanka	-27%	100	0.71	-17%	67	0.48	-34%	121	0.86	-34%	127	0.90	-43%	157	1.11
Rest of World	-26%	1191	0.19	-19%	1017	0.16	-33%	1385	0.22	-33%	1742	0.27	-42%	2081	0.33
North America	-18%	1038	0.01	-11%	1042	0.01	-23%	983	0.01	-34%	-1302	-0.01	-44%	-1830	-0.02
Colombia	-11%	-38	-0.05	-8%	-31	-0.04	-15%	-49	-0.06	-36%	-117	-0.15	-46%	-151	-0.20
Peru	-30%	66	0.14	-22%	35	0.07	-36%	86	0.18	-34%	91	0.19	-43%	109	0.23
Venezuela	-19%	32	0.03	-12%	21	0.02	-26%	41	0.04	-36%	79	0.07	-46%	88	0.08
Rest of Latin America	-2%	90	0.28	-1%	39	0.12	-4%	126	0.39	-36%	82	0.26	-45%	103	0.32
Argentina	-15%	1349	0.56	-10%	1112	0.46	-21%	1572	0.65	-32%	419	0.17	-41%	560	0.23
Brazil	-24%	1188	0.27	-16%	918	0.21	-31%	1381	0.31	-33%	1044	0.23	-42%	1298	0.29
Chile	-1%	-31	-0.05	-1%	-48	-0.08	-6%	-16	-0.03	-37%	76	0.12	-47%	91	0.15
Uruguay	-2%	110	0.64	-1%	54	0.31	-4%	154	0.88	-31%	81	0.47	-41%	109	0.63

[a]USD million, [b] % per capita relative to base

Source: GTAP simulations using GTAP and WITS data

Annex Table 16. (continued) Swiss and linear formulas compared

	Swiss 10			Flexible Swiss 10 b= 0.5			Flexible Swiss 10 b= 1.5			Linear 40% cut			Linear 50% cut		
	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]	Tariff revenue	Welfare [a]	Welfare relative to base [b]
European Union	-8%	3972	0.05	-3%	3092	0.04	-14%	4388	0.06	-32%	2621	0.04	-41%	3032	0.04
Rest of Europe	-17%	456	0.11	-16%	309	0.08	-20%	665	0.17	-34%	455	0.11	-44%	515	0.13
Turkey	-16%	300	0.23	-14%	245	0.19	-17%	346	0.26	-28%	299	0.23	-37%	368	0.28
Rest of MENA	-15%	600	0.08	-11%	393	0.05	-20%	781	0.10	-36%	985	0.13	-45%	1182	0.16
Morocco	-55%	241	0.79	-52%	234	0.77	-59%	247	0.81	-30%	154	0.50	-39%	165	0.54
Rest of Sub-Saharan Africa	-71%	1226	0.49	-60%	1173	0.47	-77%	1257	0.50	-32%	1102	0.44	-42%	1294	0.52
Zambia	-17%	22	0.67	-13%	20	0.61	-21%	23	0.69	-34%	12	0.37	-44%	15	0.45
Zimbabwe	-44%	53	0.67	-35%	44	0.55	-50%	58	0.74	-30%	29	0.36	-39%	37	0.46
Uganda	-11%	-11	-0.2	-8%	-4	-0.08	-13%	-15	-0.28	-38%	-18	-0.33	-48%	-22	-0.42
Malawi	-17%	10	0.66	-13%	9	0.55	-20%	13	0.83	-33%	9	0.57	-43%	11	0.73
Mozambique	-12%	7	0.21	-11%	6	0.19	-13%	7	0.20	-38%	-2	-0.06	-48%	-2	-0.07
Tanzania	-37%	-27	-0.3	-32%	-20	-0.23	-41%	-32	-0.37	-36%	-36	-0.41	-45%	-46	-0.53
Madagascar	-5%	5	0.11	-3%	2	0.05	-6%	6	0.14	-38%	1	0.01	-48%	1	0.02
	average	sum	average	average	sum	average	average	sum	average	average	sum	average	average	sum	average
Total	-25%	35378	0.39	-20%	30375	0.33	-30%	38928	0.44	-33%	28439	0.31	-42%	34685	0.38
Developing	-25%	14964	0.43	-20%	12605	0.35	-30%	16863	0.48	-33%	14982	0.34	-43%	18374	0.42
Developed	-25%	20415	0.24	-21%	17770	0.20	-29%	22064	0.27	-31%	13457	0.18	-40%	16311	0.22

[a]USD million, [b] % per capita relative to base
Source: GTAP simulations using GTAP and WITS data.

Annex Table 17. Private households' consumption and imports at market prices

(USD million)

	Domestic purchases (1)	Imports (2)	Ratio (2/1)
Argentina	188466.7	4310.6	2.3%
India	293254.2	9220.2	3.1%
Bangladesh	32248.3	1472.4	4.6%
China	520133.8	31209.5	6.0%
Venezuela	82262.6	4976.3	6.0%
Brazil	260787.5	17070.3	6.5%
Peru	34115.5	2293.8	6.7%
Uruguay	12176.6	864.5	7.1%
Uganda	4370.4	310.9	7.1%
Madagascar	3128.1	297.3	9.5%
Tanzania	7391.0	742.9	10.1%
Chile	35358.1	3604.9	10.2%
Zimbabwe	5927.3	659.4	11.1%
Colombia	44954.5	5090.2	11.3%
Zambia	2182.4	295.5	13.5%
Indonesia	80179.1	11074.7	13.8%
Sri Lanka	8902.7	1332.4	15.0%
Morocco	18244.6	2858.5	15.7%
Malawi	979.3	169.2	17.3%
Mozambique	1854.6	371.6	20.0%
Vietnam	17827.6	3574.1	20.0%
Thailand	51800.3	12335.9	23.8%
Philippines	36857.4	10063.1	27.3%
Singapore	22134.9	10592.5	47.9%
Malaysia	18936.3	14761.6	78.0%

Source : GTAP database

Annex Table 18. Comparison of estimates from general equilibrium simulations with and without tax replacement

	Original simulation						Simulation with replacement of tariff revenue with consumption tax					
	Trade impact			Welfare impact			Trade impact			Welfare impact		
	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15	Swiss5	Swiss10	Swiss15
Argentina	13.5	2.9	1.7	2049.9	1349.3	994.0	13.5	7.1	4.5	2016.8	1334.7	986.8
Bangladesh	25.4	16.1	10.9	131.4	119.8	94.2	25.3	17.5	11.6	124.3	116.2	93.2
Brazil	9.4	2.8	1.3	1264.0	1188.0	1037.0	9.3	5.2	3.1	1082.4	1109.3	1008.2
Chile	2.3	-0.2	-0.2	-17.0	-30.6	-44.4	2.2	-0.6	-0.6	-46.1	-32.9	-46.3
China	13.1	10.2	8.6	3753.4	2305.6	1509.1	12.8	9.6	7.9	3374.0	2004.8	1248.3
Colombia	2.5	0.8	0.4	-152.9	-37.5	-4.0	2.4	0.4	0.2	-173.0	-43.1	-6.2
India	38.5	29.9	24.9	1982.1	1936.5	1832.1	38.0	30.7	25.5	1844.7	1827.5	1743.7
Indonesia	3.7	0.9	0.6	842.2	676.3	559.9	3.7	2.1	1.6	810.6	658.0	546.0
Madagascar	0.7	0.5	0.5	7.4	4.5	2.6	0.7	0.5	0.4	7.0	4.4	2.5
Malawi	9.7	0.8	-0.1	17.5	10.2	6.5	9.6	4.1	1.8	16.5	9.9	6.4
Malaysia	4.4	1.3	1.1	1262.5	1007.9	849.6	3.6	2.4	1.9	939.6	792.2	672.0
Morocco	26.8	25.0	19.9	196.8	240.7	257.3	26.6	20.8	16.5	101.9	174.7	209.9
Mozambique	3.1	1.6	0.4	4.2	6.8	7.6	3.0	1.3	0.7	3.2	7.0	8.1
Peru	10.3	6.5	3.0	85.9	65.6	42.8	10.2	5.6	2.4	73.2	59.1	40.9
Philippines	1.0	0.3	0.0	152.8	99.0	67.7	1.0	0.4	0.1	154.3	101.8	71.2
Sri Lanka	7.2	2.3	1.8	158.2	100.1	63.4	7.2	4.3	2.7	150.9	97.3	62.7
Tanzania	7.1	9.2	5.1	-55.0	-26.7	-9.8	7.2	4.4	2.5	-54.4	-26.3	-9.5
Thailand	12.5	4.9	3.6	1810.1	1475.8	1247.2	11.9	8.4	6.1	1511.8	1276.4	1105.4
Uganda	-0.1	1.4	0.3	-19.2	-10.5	-7.0	-0.1	-0.4	-0.6	-19.2	-10.7	-7.2
Uruguay	3.4	-0.2	-0.1	158.1	110.3	92.9	3.4	1.7	1.4	156.9	110.6	93.3
Venezuela	3.6	1.0	0.4	38.2	32.0	-8.8	3.5	1.2	-0.1	13.6	21.7	-12.5
Vietnam	14.1	6.8	4.1	542.4	453.6	376.2	13.7	8.9	5.7	506.8	434.2	365.7
Zambia	7.0	1.6	0.4	25.3	21.8	19.3	7.0	3.6	2.1	25.2	22.2	19.8
Zimbabwe	14.3	5.5	3.5	61.4	52.8	48.3	14.4	10.4	7.9	62.1	53.5	48.8

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

Source : GTAP model simulations using GTAP and WITS data

Annex Table 19. Comparison of estimates from general equilibrium simulations with and without tax replacement

	Percentage per capita welfare gains relative to base					
	No tariff revenue replacement			Tariff revenue replacement with consumption tax		
	Swiss5	Swiss10	Swiss 15	Swiss5	swiss10	Swiss 15
Argentina	0.84	0.56	0.41	0.83	0.55	0.41
Bangladesh	0.31	0.28	0.22	0.29	0.27	0.22
Brazil	0.28	0.27	0.23	0.24	0.25	0.23
Chile	-0.03	-0.05	-0.07	-0.08	-0.05	-0.08
China	0.36	0.22	0.14	0.32	0.19	0.12
Colombia	-0.2	-0.05	-0.01	-0.22	-0.06	-0.01
India	0.45	0.44	0.42	0.42	0.42	0.4
Indonesia	0.63	0.51	0.42	0.61	0.49	0.41
Madagascar	0.18	0.11	0.06	0.17	0.1	0.06
Malawi	1.12	0.66	0.42	1.06	0.63	0.41
Malaysia	1.62	1.29	1.09	1.21	1.02	0.86
Morocco	0.64	0.79	0.84	0.33	0.57	0.69
Mozambique	0.13	0.21	0.23	0.1	0.21	0.25
Peru	0.18	0.14	0.09	0.15	0.12	0.08
Philippines	0.24	0.16	0.11	0.24	0.16	0.11
Sri Lanka	1.12	0.71	0.45	1.07	0.69	0.44
Tanzania	-0.63	-0.3	-0.11	-0.62	-0.3	-0.11
Thailand	1.82	1.48	1.25	1.52	1.28	1.11
Uganda	-0.36	-0.2	-0.13	-0.36	-0.2	-0.14
Uruguay	0.91	0.64	0.53	0.9	0.64	0.54
Venezuela	0.03	0.03	-0.01	0.01	0.02	-0.01
Vietnam	1.86	1.56	1.29	1.74	1.49	1.26
Zambia	0.77	0.67	0.59	0.77	0.68	0.6
Zimbabwe	0.77	0.67	0.61	0.78	0.67	0.62

[1]Bound rates are reduced according to the Swiss formula. Applied rates are reduced only in cases where the resulting bound rates fall below the level of initial applied rate.

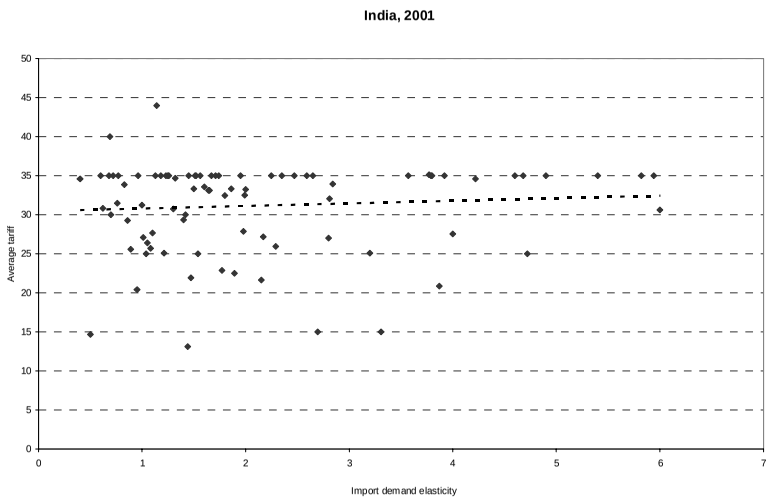
Source : GTAP model simulations using GTAP and WITS data.

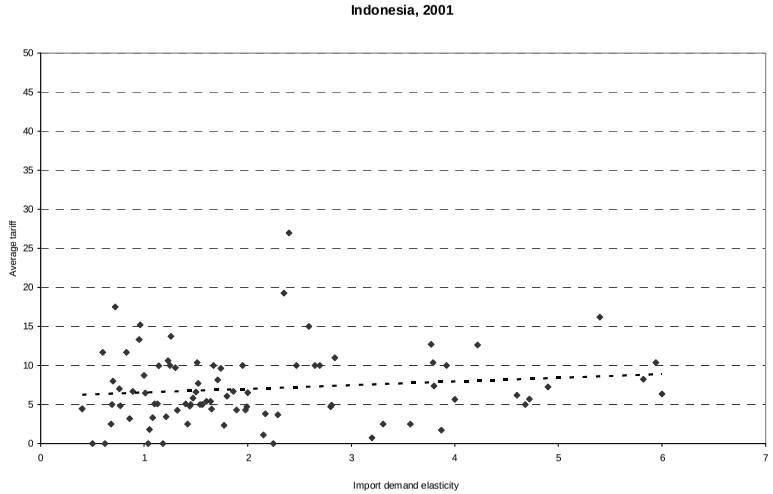
Annex Table 20. Private domestic consumption taxes, % ad valorem rate

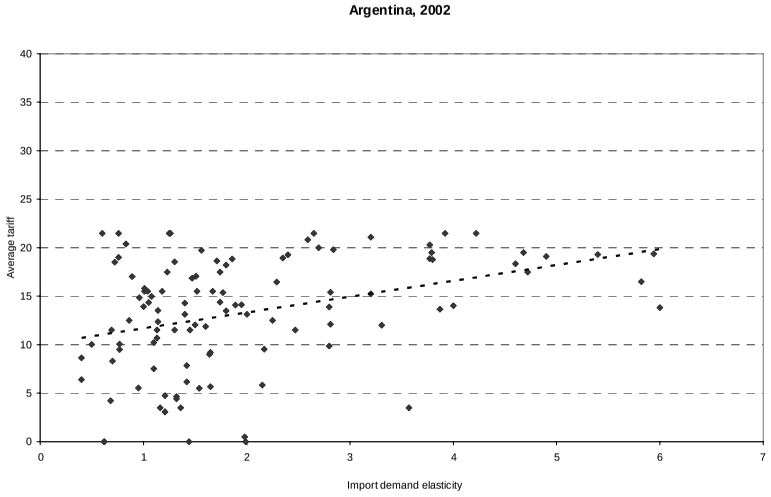
	Natural resources	Primary agriculture	Processed agriculture	Textiles, apparel and leather	Chemical, rubber and plastic products	Wood products	Motor vehicles and parts	Other machinery and equipment	Other manufacturing (not classified elsewhere)	Services
China	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indonesia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.2
Malaysia	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.3
Philippines	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Thailand	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.4
Vietnam	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bangladesh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
India	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.6	0.0
Sri Lanka	0.0	8.0	29.9	2.0	12.3	8.0	22.1	11.8	2.8	5.9
Colombia	-0.2	0.1	14.7	21.6	12.6	0.0	65.2	78.6	37.3	1.9
Peru	-1.5	-0.5	3.5	0.4	1.2	0.5	1.7	-1.3	53.4	1.5
Venezuela	0.2	0.0	9.6	0.3	0.7	0.6	0.6	0.0	3.6	1.7
Argentina	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	0.8	49.2	1.1
Brazil	0.0	10.3	22.4	25.5	20.1	18.6	18.6	24.2	47.3	3.3
Chile	1.9	15.9	18.0	18.0	14.2	18.0	9.7	11.2	77.3	2.9
Uruguay	0.0	4.2	19.0	11.4	7.0	11.7	12.2	32.7	90.8	5.2
Morocco	0.0	-1.9	-1.1	20.0	20.0	20.0	20.0	21.0	11.5	5.2
Zambia	0.0	0.5	2.9	0.0	9.4	0.0	0.0	0.0	7.3	0.4
Zimbabwe	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Uganda	0.0	0.0	0.0	0.0	0.0	0.0	2.7	-5.8	0.0	0.0
Malawi	0.0	0.3	36.9	24.1	3.4	5.0	0.0	0.0	4.9	1.6
Mozambique	0.8	1.9	9.5	9.7	6.4	9.7	3.8	3.8	8.7	1.4
Tanzania	0.0	1.1	3.9	4.6	1.7	0.1	15.1	8.5	13.7	0.0
Madagascar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

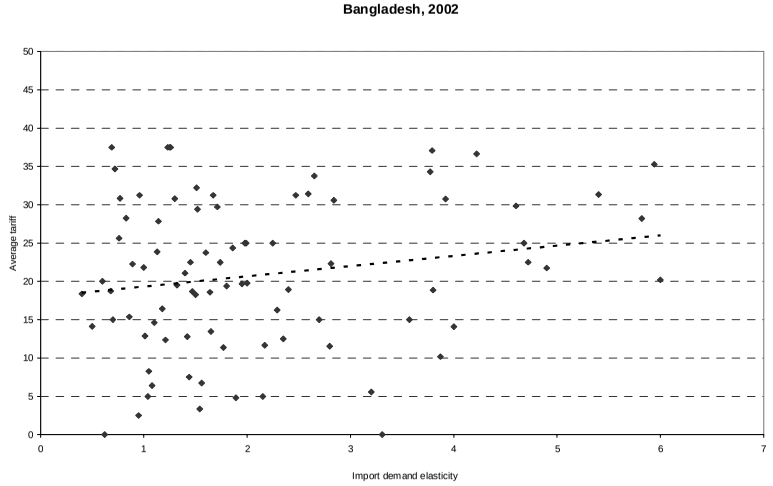
Source: GTAP

Annex Figure 1. Average applied tariff rates by import demand elasticity.

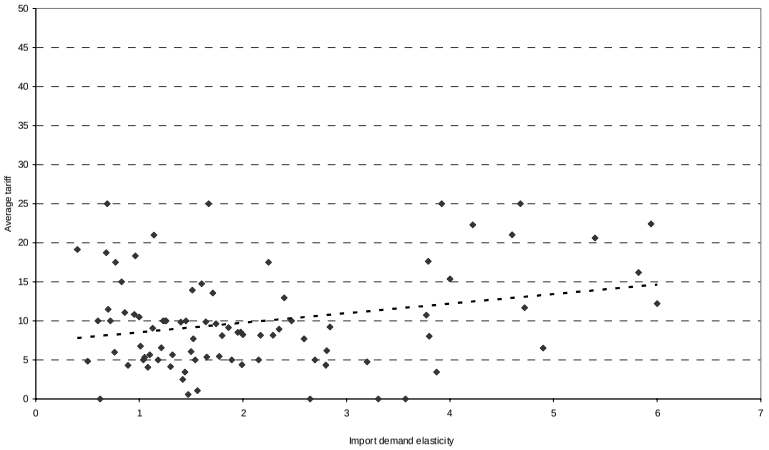




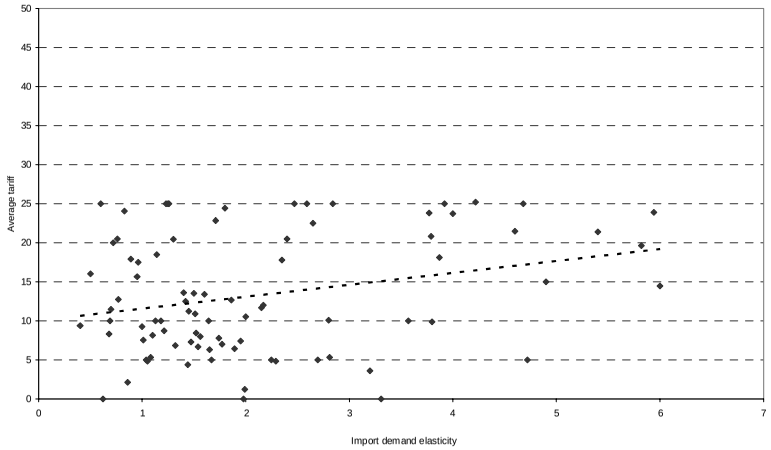




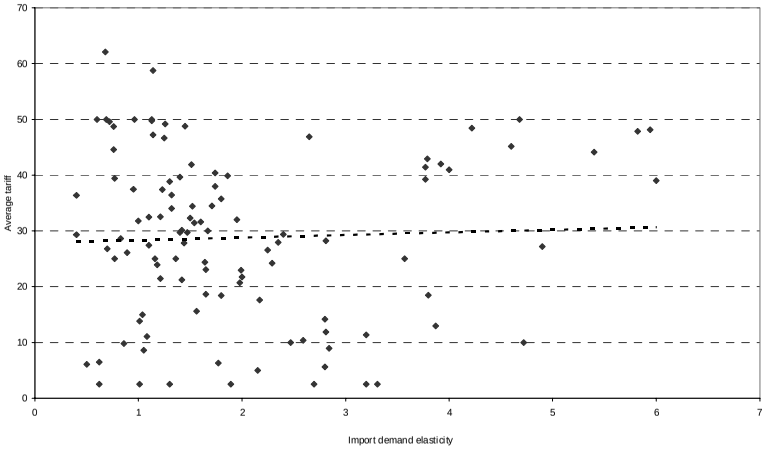
Sri Lanka, 2001



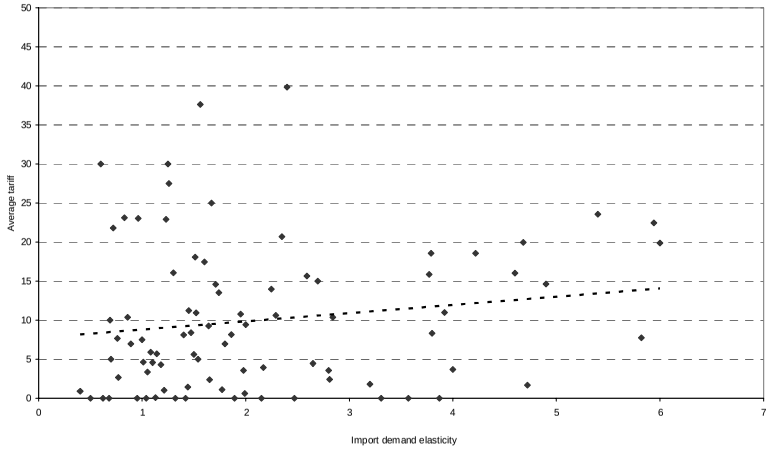
Malawi, 2001

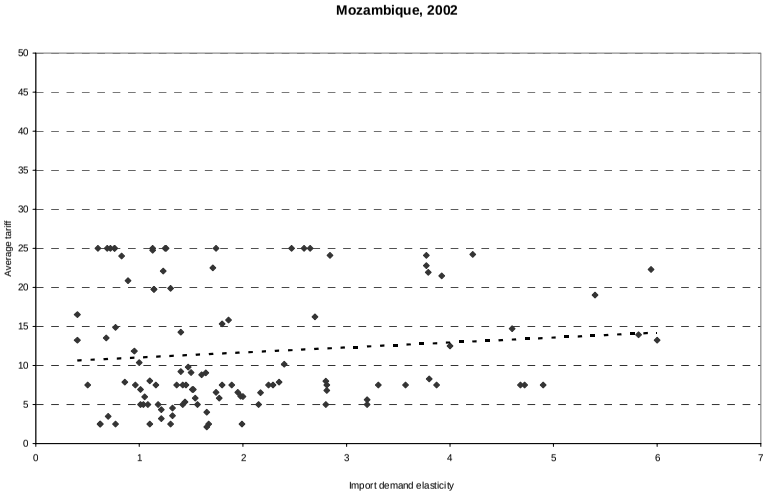


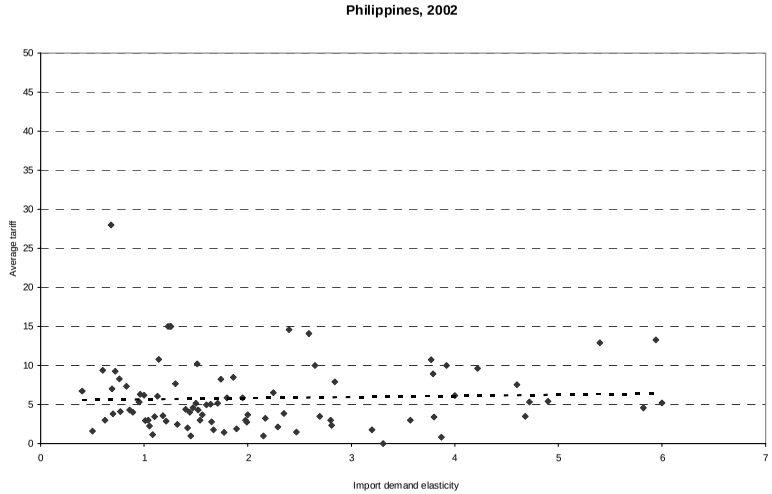
Morocco, 2002

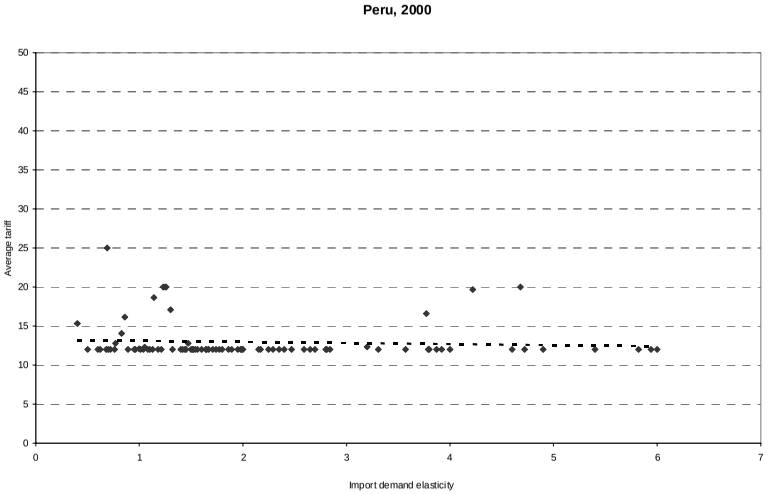


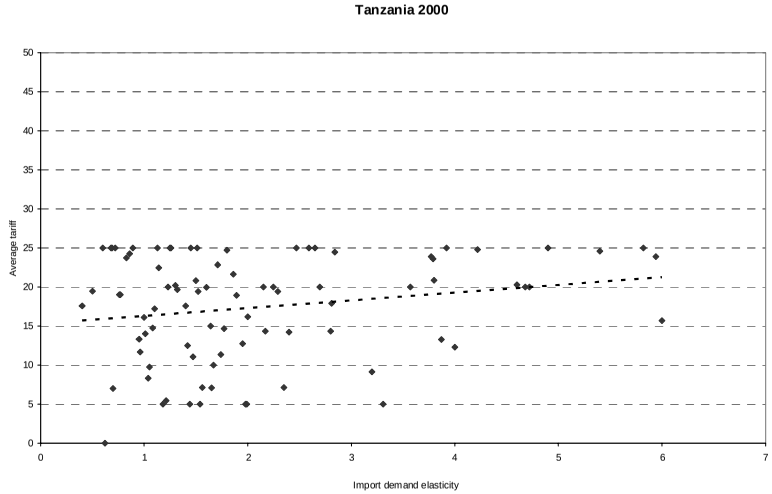
Malaysia, 2001



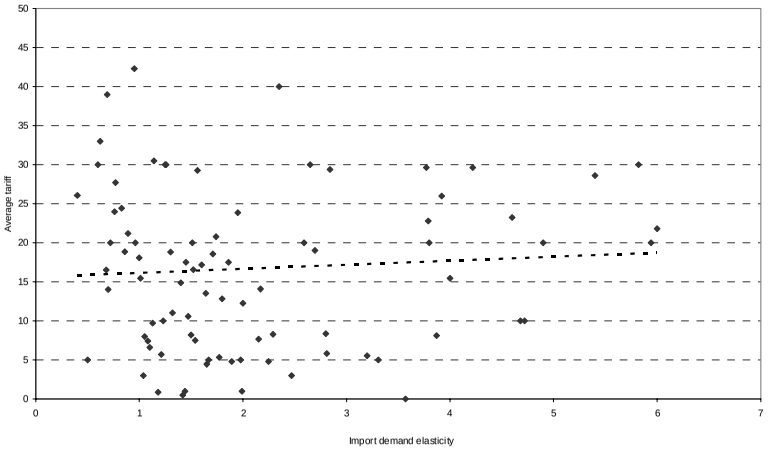

Mozambique, 2002
Average tariff
Import demand elasticity


Philippines, 2002
Average tariff
Import demand elasticity

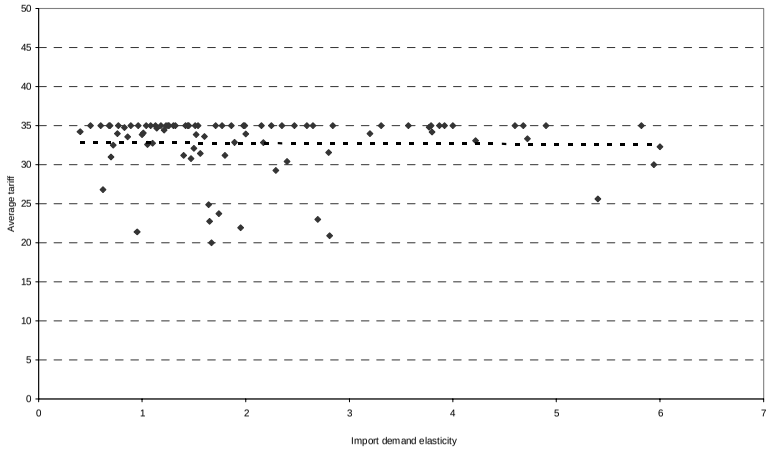

Peru, 2000
Average tariff
Import demand elasticity


Tanzania 2000
Average tariff
Import demand elasticity

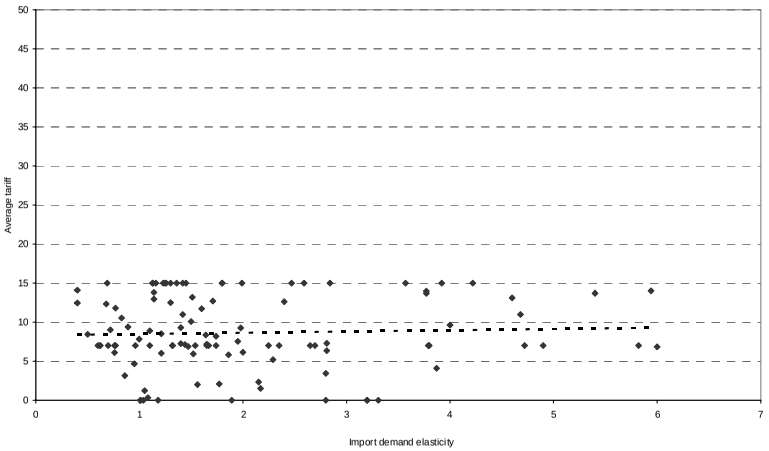
Thailand, 2001



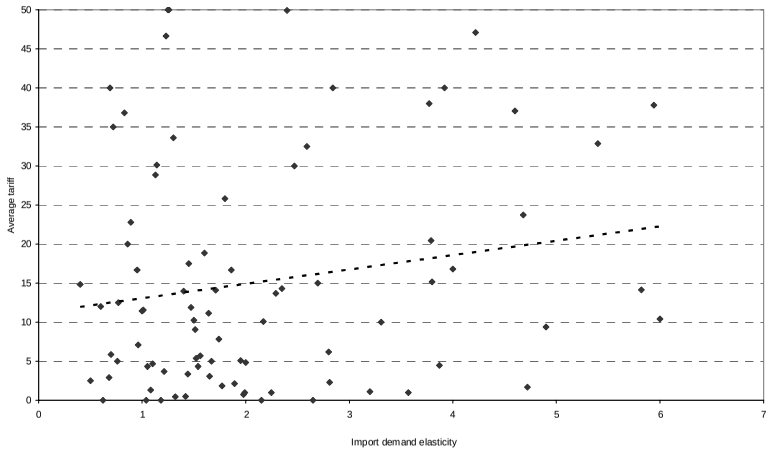
Uruguay, 2001



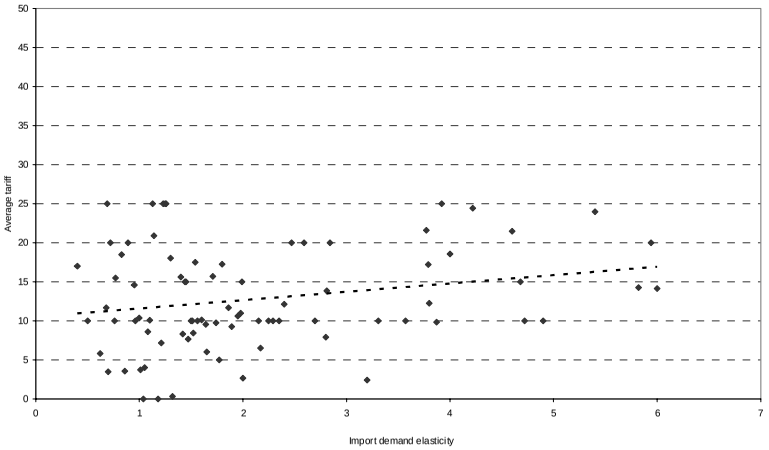
Uganda, 2002



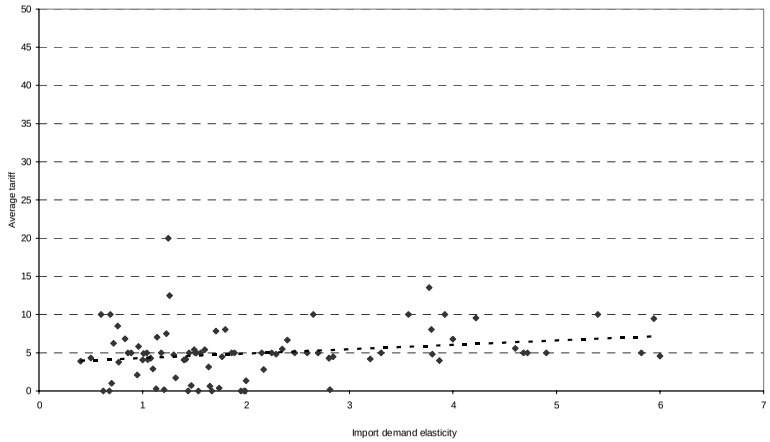
Vietnam, 2001



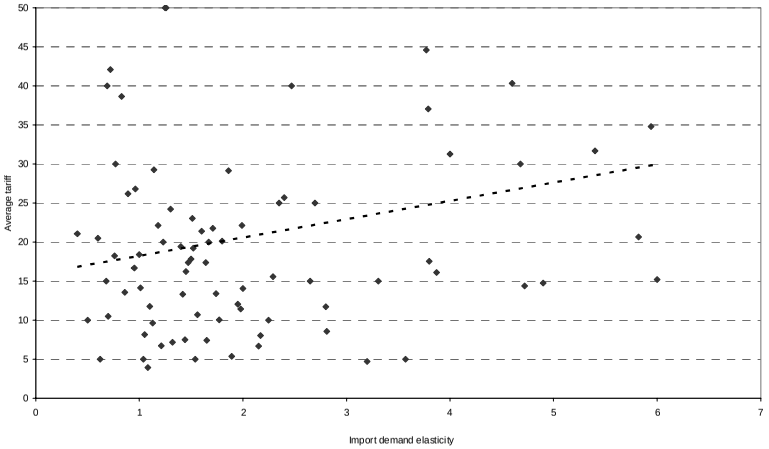
Zambia, 2002



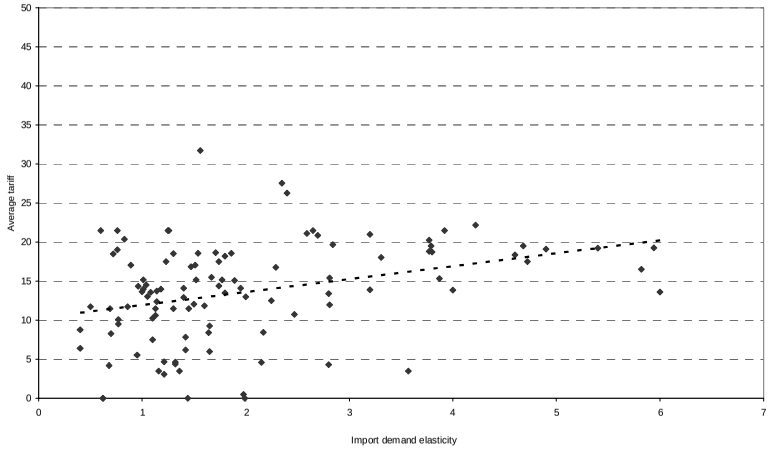
Madagascar, 2001



Zimbabwe, 2001

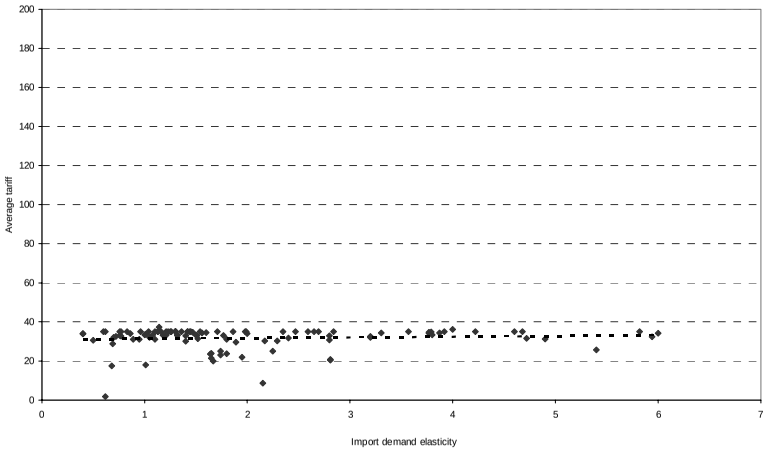


Brazil, 2002

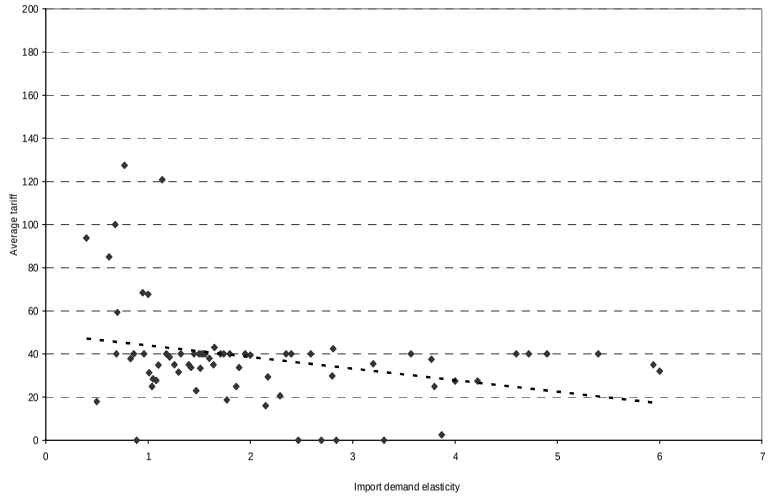


Annex Figure 2. Average bound tariff rate by import demand elasticity

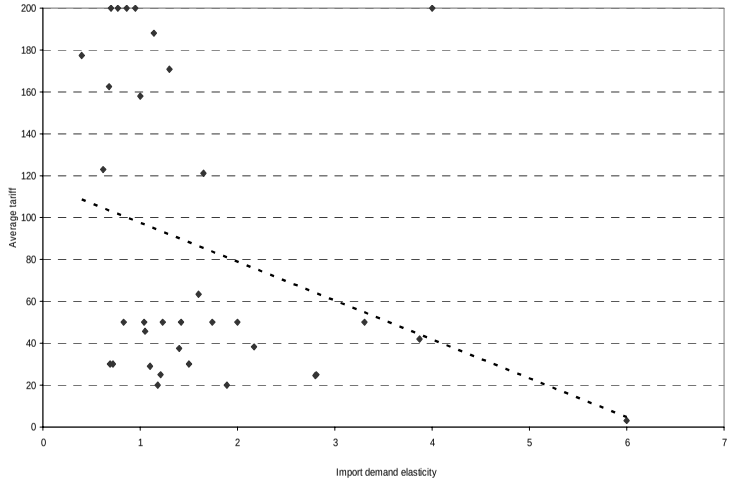
Brazil 2002



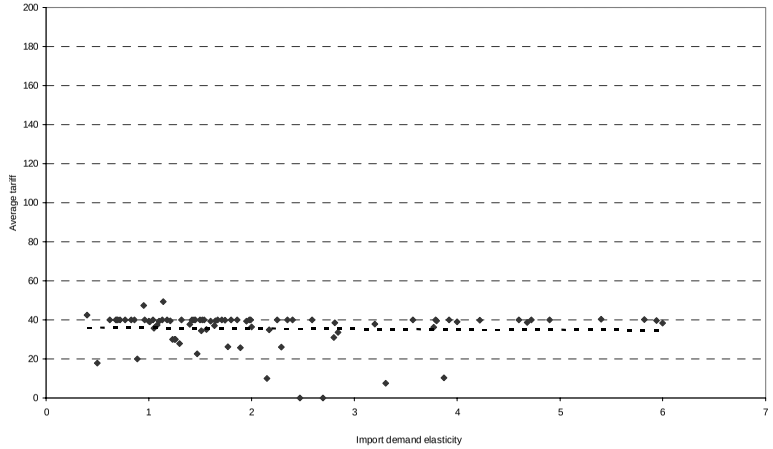
India, 2001



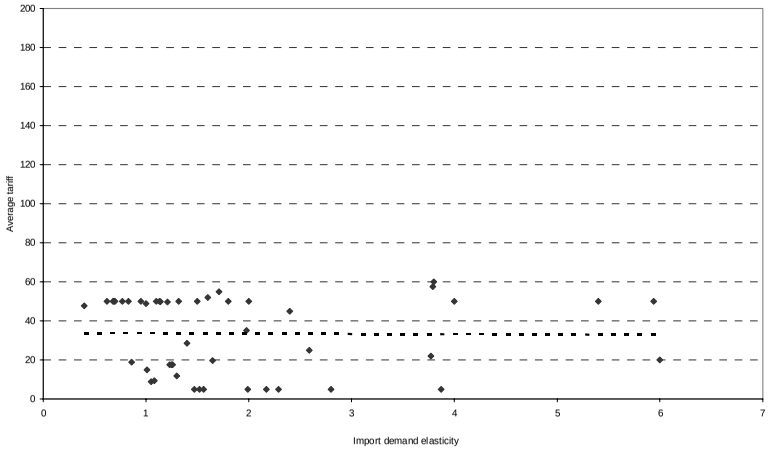
Bangladesh, 2002



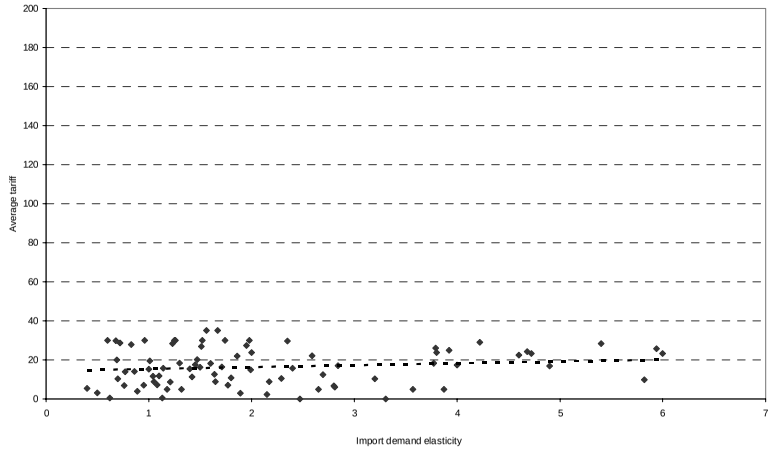
Indonesia, 2001



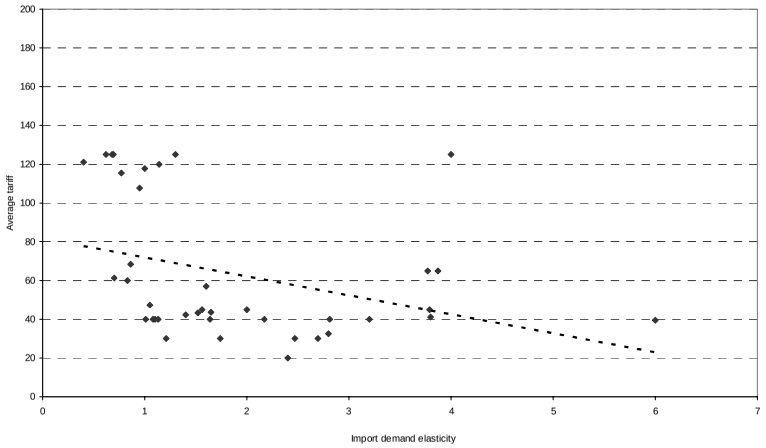
Sri Lanka 2001



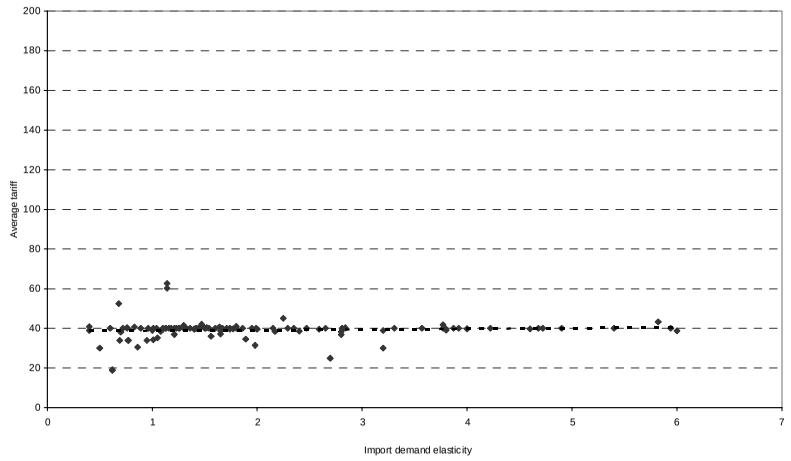
Malaysia 2002



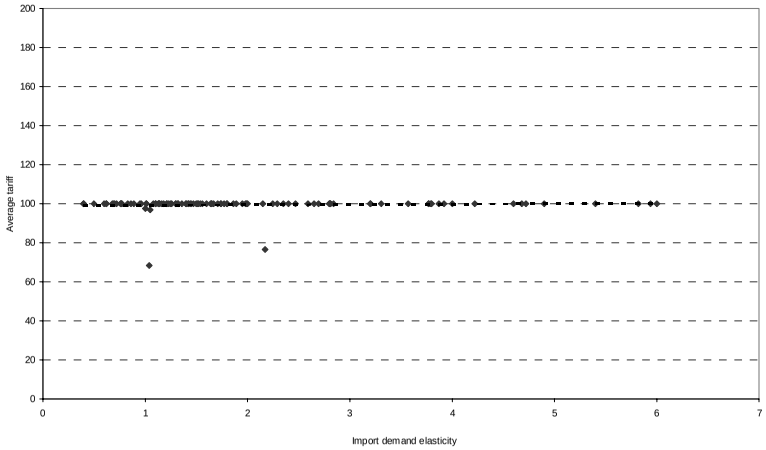
Malawi, 2001



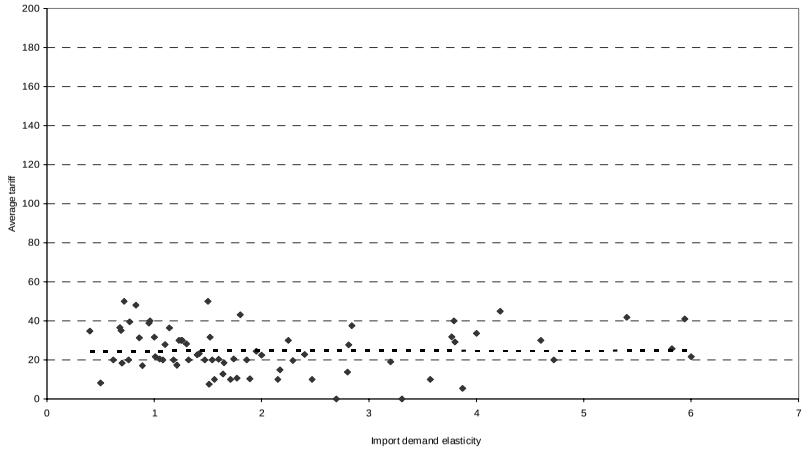
Morocco, 2002



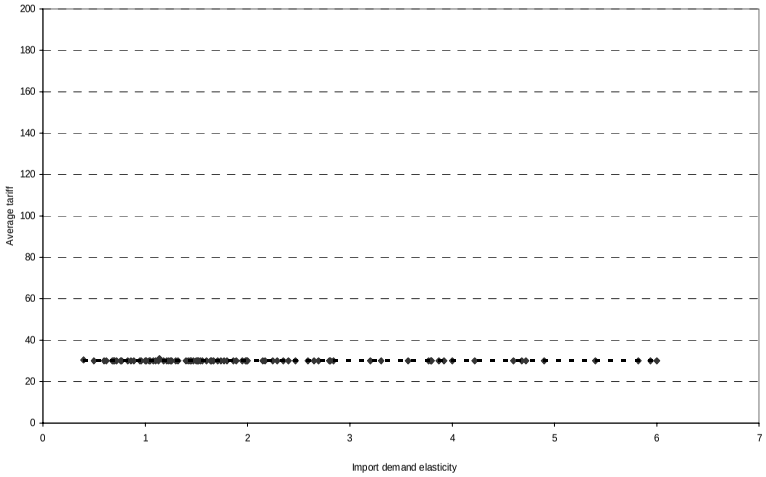
Mozambique, 2002



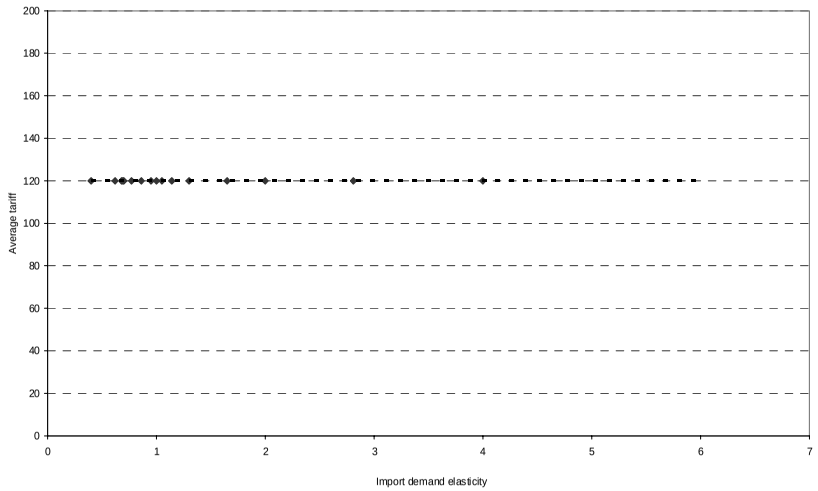
Philippines, 2002



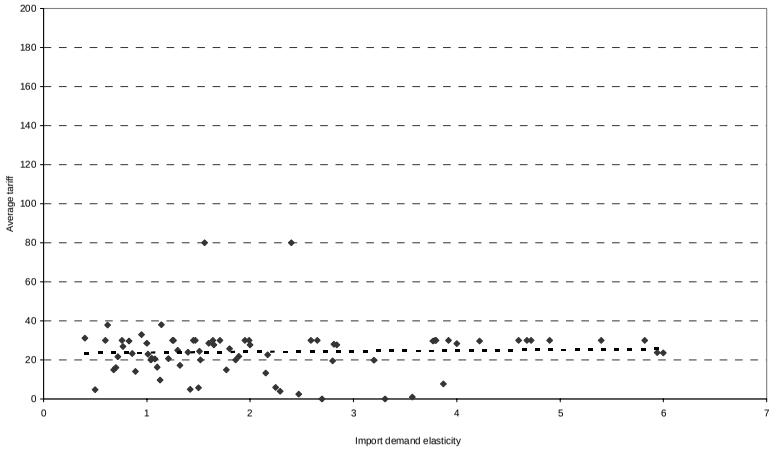
Peru, 2000



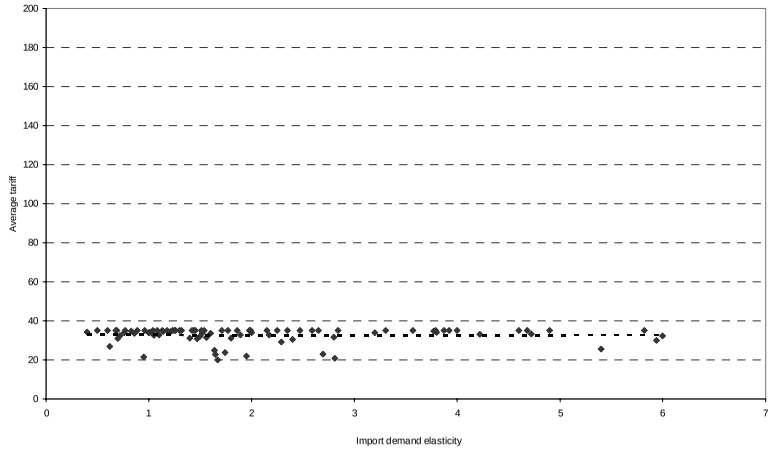
Tanzania, 2000



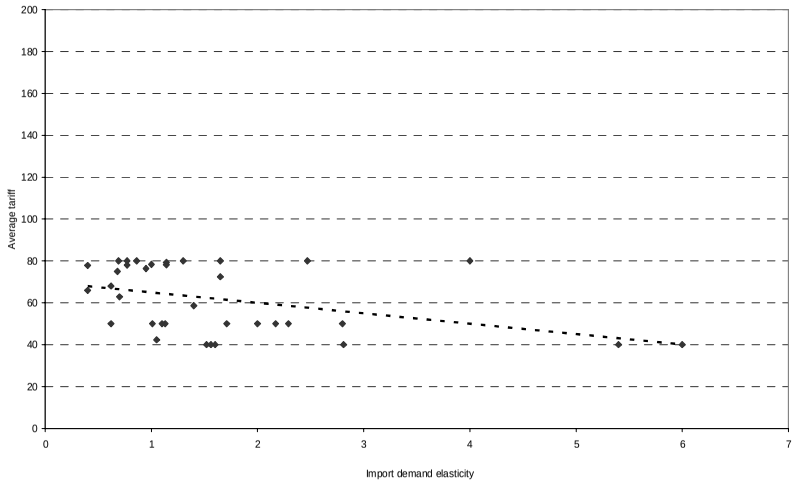
Thailand, 2001



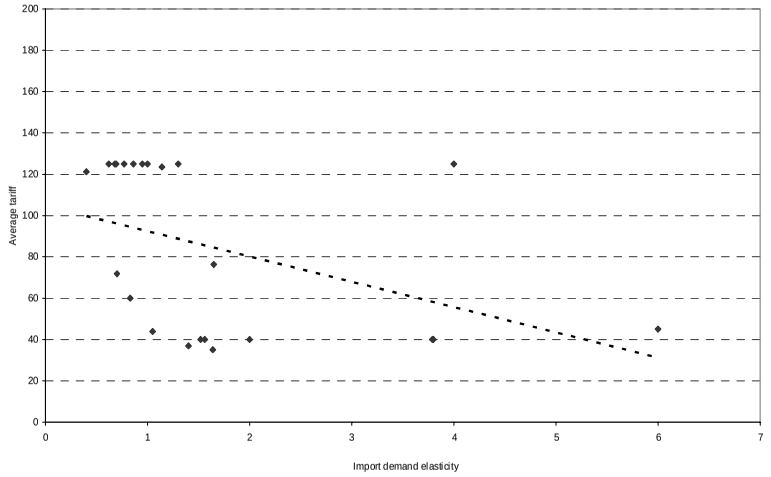
Uruguay, 2001



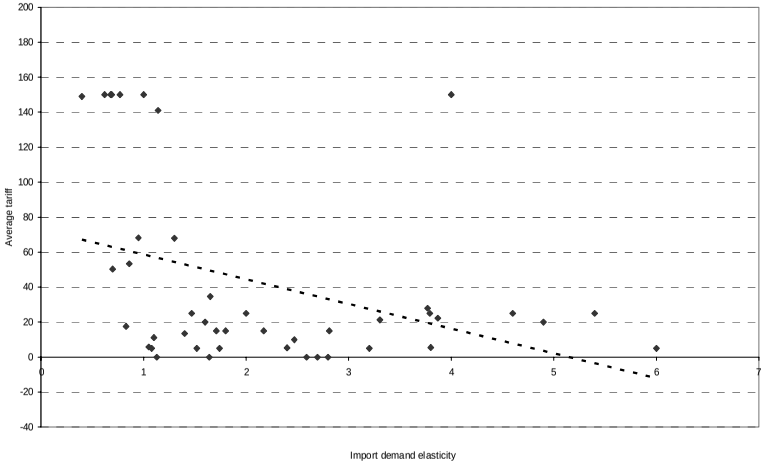
Uganda 2002



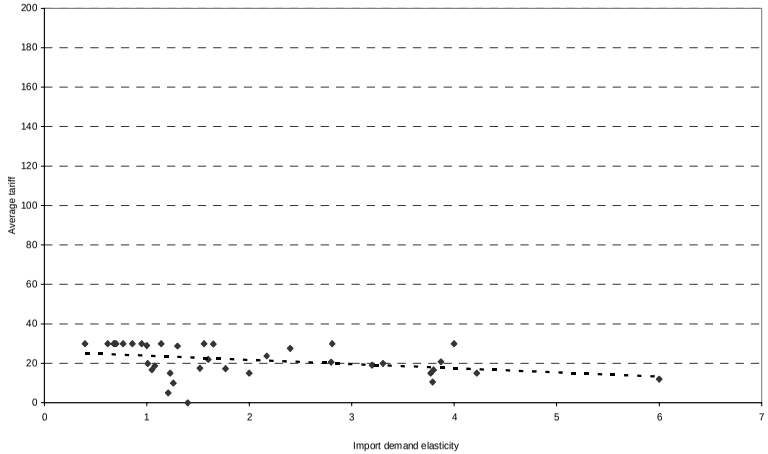
Zambia, 2002



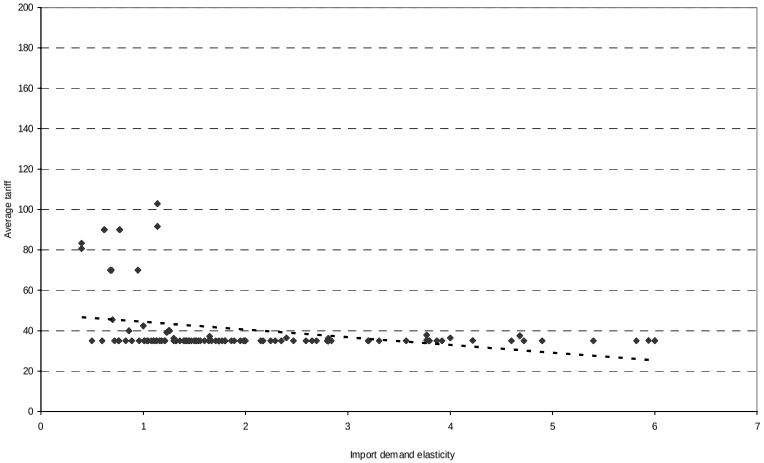
Zimbabwe, 2001



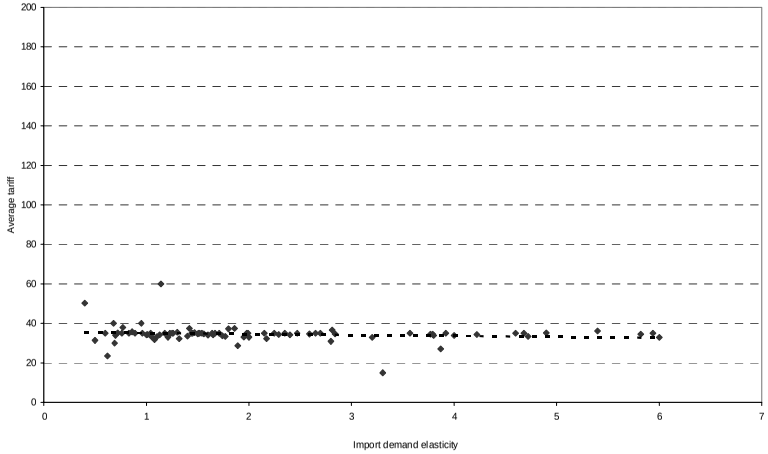
Madagascar, 2001



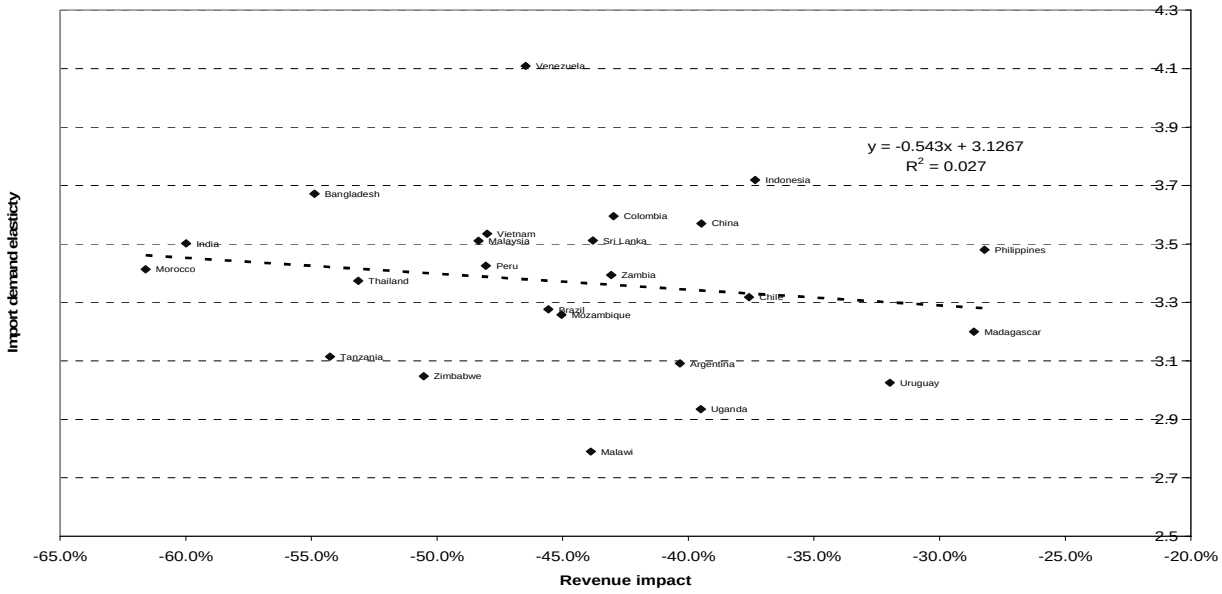
Colombia, 2002



Venezuela, 2000

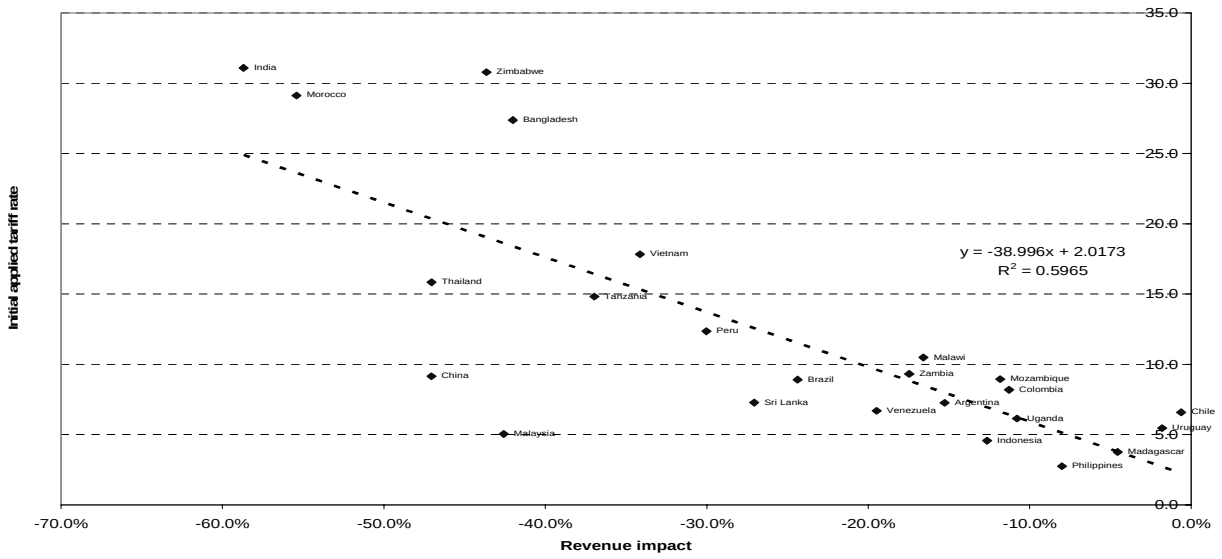


Annex Figure 3. General equilibrium simulation: revenue effect by average trade weighted import demand elasticity (Swiss formula 10).



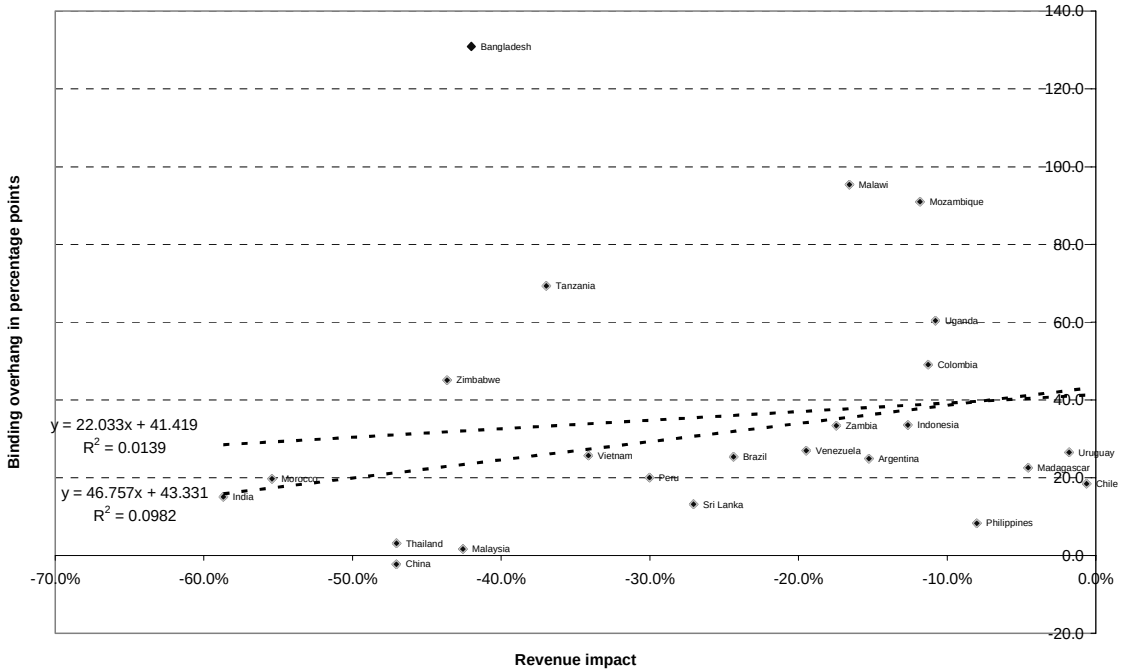
Source: GTAP simulations

Annex Figure 4. General equilibrium simulation revenue effect by average trade weighted initial applied tariff rate (Swiss formula 10)



Source: GTAP simulations

Annex Figure 5. General equilibrium simulation revenue effect by binding overhang (Swiss formula 10)



Source: GTAP simulations