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ORIGINAL PAPER

The role of coalitions at international tariff negotiations: a CGE perspective

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Abstract
Developing countries coalitions form an integral part of tariff negotiations that take place under the aegis of the World Trade Organization. While there was only a single coalition in the 70s, their number increased to 31 in the year 2005. Despite the apparent proliferation of coalitions in tariff negotiations, little research on their theoretical and empirical implications has been produced. In particular, we lack an understanding of efficiency and equity effects of coalitions. By exploring this equity-efficiency nexus, the study finds that developing countries coalitions like the G-90 and the Least Developed Countries Group – while benefiting member countries – lead to less efficiency and less equity overall. Forming the Cairns Group, however, leads to a more efficient and equal distribution of the gains from trade.

Keywords Coalitions · Developing countries · Multilateral negotiations · CGE

1 Introduction

Coalitions like the G-10, G-20, G-90, Cairns or the Least Developed Countries (LDC) Group form an integral part of tariff negotiations that take place under the aegis of the World Trade Organization (WTO). While there was only a single coalition in the 70s, their number increased to 31 in the year 2005, see Patel (2007). Despite of the apparent proliferation of coalitions in tariff negotiations, surprisingly little research on their theoretical and empirical implications has been produced, see Rolland (2007). In particular, we lack an understanding of efficiency and equity effects of coalitions. On the one hand, coalitions may act as a means to improve the bargaining outcome of weaker countries, see WTO (2012). By giving weaker countries a stronger voice, coalitions should lead to a more equal division of gains from trade. On the other hand, some authors agree that active participation of certain coalitions is one of the main reasons for the Doha stalemate, compare Narlikar (2005),

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Patel (2007) and Bouët and Laborde (2010). This implies that coalitions act like a stumbling block to broader liberalization which results, in principle, in decreasing overall efficiency. Because of this potential trade-off, a serious evaluation of coalitions should take into account both, equity and efficiency considerations.

Tariff negotiations are increasingly complex. The number of WTO members is steadily increasing and amounts to 164 countries in 2020.[1] Due to the proliferation and differing interests of member states, it is hard to arrive at a conclusion. Moreover, it is not clear which part individual countries play and how to assess coalitions against this background, see Schott and Watal (2000). In early GATT times, the whole process was easier since there was only a small number of countries effectively participating at the negotiations. The so-called Quad countries (EU, USA, Japan, Canada) were dominating the bargaining table and did not insist on the active participation of the remaining members; also coalitions were not present at this time. It was commonplace that tariff reductions were negotiated by the Quad countries which were then transmitted to the remaining countries via the Most Favoured Nations (MFN) principle. Since this procedure allowed the non-participating countries to free-ride on the Quad countries negotiations, they had little incentive to participate actively. The Uruguay Round in 1986 changed the rules of the game by introducing the *single undertaking* principle. This implies – amongst others – that all countries have to adhere to the policies that have been negotiated by a subset of all member states. As a consequence, the number of countries actively sitting at the bargaining table - including developing countries - was increasing significantly, see Schott (1996) and Hudec (1987). Although many developing countries were now more involved in the activities at the WTO, most of them were facing a problem of marginalization. This is mainly driven by a lack of economic bargaining power which is usually also mirrored by a lack of WTO delegates in Geneva, see Ostry (2009). In principle, all decisions within the WTO have to be decided in consensus and all members have the same voice.[2] But in practice, the negotiation process is complex and the distribution of economic power plays a key role. This may rationalize the formation of coalitions – another novelty at the Uruguay Round – as a means to give otherwise marginalized countries a voice at the negotiations. Rolland describes this – with a focus on developing countries – as follows:

> ... in most instances, developing countries have to act in coalitions in order to gain sufficient leverage and some developing country members have little – if any – voice if they do not ally with others. Despite their increased number and activity in the WTO, developing countries still find themselves in a relatively marginalized position and experience difficulties in linking their development agenda to multilateral trade negotiations...[3]

[1] Afghanistan, joining in July 2016, is the most recent member of the organization.

[2] 'A consensus rule is quite similar to unanimity, except that consensus in the WTO can be reached provided no objections are raised to a decision. Unanimity would require that all parties explicitly agree to the decision.' (Low (2011), p. 3).

[3] Rolland (2007), p. 487.

As already mentioned, there is a paucity of literature on the topic, although coalitions have been formally defined in the context of cooperative game theory long time ago, see e.g. Mas-Colell et al. (1995), pp. 673, for the theoretical underpinnings. But there is only a small research community that uses methods from cooperative game theory to analyse coalition formation processes in the context of international tariff negotiations, see e.g. Aghion et al. (2007), Das and Ghosh (2006) and Saggi and Sengul (2009). It has to be mentioned, however, that this literature treats coalitions as formations of preferential trade agreements (Aghion et al. (2007) and Das and Ghosh (2006)) or as clubs that exchange MFN status (Saggi and Sengul (2009)), which is not the mode of action of coalitions in WTO negotiations like the G-90 or Cairns Group where members seek to increase bargaining power in tariff negotiations.[4] In an empirical context, Costantini et al. (2007) analyse the internal coherence of existing coalitions with a cluster analysis. They identify so called natural members of coalitions that share many characteristics and strategical members that differ in their characteristics. By employing a meta analysis, Cepaluni et al. (2012) find that the probability of success of coalitions is increasing in the number of its members. While the latter two empirical studies focused on the nature of coalitions, there is a study by Bouët and Laborde (2010) that investigates – amongst others – the consequences that existing coalitions might have in economic terms. They employ Modelling International Relationships in Applied General Equilibrium (MIRAGE), a CGE model, with Global Trade Analysis Project (GTAP) base data version 6.1 to tackle this questions. One of the key findings is that under the circumstances of the underlying assumptions, the appearance of the G-90 empties the core of the game and thereby improves the situation for Sub-Saharan Africa and Bangladesh relative to a no-coalition world.

This article aims to shed light on the following questions: (i) (How) Do coalitions help developing countries? and (ii) What is the consequence for the international trading system as a whole, especially in terms of equity and efficiency? To answer these pending questions, we employ a standard computational general equilibrium model which is extended to incorporate bargaining issues. The paper adds to the existing literature by endogenously determining the outcome of multilateral tariff negotiations using a fine grid of reciprocal tariff reductions and thereby exploring the equity-efficiency nexus of coalitions.

2 Materials and methods

For the evaluation of coalitions, we employ Rutherford's GTAP6inGAMS version of the GTAP model, see Rutherford (2005). The standard GTAP model is a static CGE model which is tailored to questions of trade policy analysis due to its broad sectoral and regional coverage. Producers act under perfect competition and constant returns to scale. Goods and services are produced with (fully employed)

[4] In a more comprehensive study, Berens et al. (2020) consider both preferential trade agreements and MFN options in their analysis.

factors like capital, labor and land and other imported and local intermediates. Governments and households generate their utility by consuming locally produced and imported goods. Intra-industrial trade is governed by the Armington assumption, see Armington (1969), and all agents are rational in a sense that everyone makes individually optimal decision in every situation. There are also some differences of the GTAP6inGAMS version relative to the standard GTAP model. Instead of a constant difference of elasticities demand system, a standard Cobb-Douglas demand system is employed in the GAMS version. In addition, investment demand and international capital flows are exogenously fixed at base year levels in the GAMS version, whereas a 'global bank' allocates international capital flows in response to changes in regional rates of return in the standard GTAP model. CGE models like GTAP are frequently employed for academic purposes as well as to inform (trade) policy makers. Despite their heavy use, these models have been criticised due to their simplifying assumptions about factor markets, limited treatment of service sector and so on. All these critiques apply to our study. An alternative to CGE models would be to employ New Quantitative Trade models that usually rely on structural gravity equations. These models have some advantages (e.g. in terms of the consistency of calibration/estimation) but also some drawbacks relative to CGE models (e.g. absence of domestic policies or more unrealistic treatment of production and demand functions), see Bekkers (2017). Given the lack of a superior alternative for trade policy analysis as pointed out by Nilsson (2018), we believe that the model still produces useful insights and is an appropriate tool in the context of our study.

At first, we need to extend the standard GTAP model in order to formally incorporate the bargaining process of international tariff negotiations. Therefore, we introduce the Nash bargaining concept into the model, see Nash (1950) and Nash (1953). While negotiations at the WTO are complex and deal with different topics such diverse as rules on intellectual property rights and environmental aspects, we focus on another important aspect of GATT/WTO, i.e. tariff reductions. To reduce the complexity of the negotiations, members have early switched from messy product-by-product negotiation to more systematic across-the-board tariff cuts. One way to introduce across-the-board tariff cuts is to apply the following formula and negotiate about the (linear) reduction parameter a:

$$\boldsymbol{\tau} = a \cdot \boldsymbol{\tau_0}, \quad a \in [0, 1]. \tag{1}$$

This formula transforms the matrix of original tariffs $\boldsymbol{\tau_0}$ into a matrix of new applied tariffs $\boldsymbol{\tau}$ according to the specific value of a. The value of $(1 - a) * 100$ can be interpreted as percentage tariff reductions. Consequently, if $1 - a$ equals zero there is no liberalization and a value of one would result in 100 per cent reduction, i.e. free-trade. Since we are looking at bilateral tariffs for a large set of sectors and countries, the 3-dimensional tariff matrix can be quite big.[5]

[5] In a model with N sectors and R regions there exist in principle $N \times R \times (R - 1)$ tariffs. In our model aggregation with $N = 22$ and $R = 26$ this amounts to 14,300 tariffs.

The next step is to translate formula (1) into the bargaining problem by employing the Nash bargaining concept shown in formula (2). In this axiomatic approach, properties are identified which should apply to any reasonable solutions, in a first step. Then, in a second step, a method is utilized which exactly satisfies these properties.[6]

$$\tilde{a} = arg \max_{a} \prod_{r} (V^r(a) - V_0^r)^{\alpha^r} \tag{2}$$

In this representation, the dependence of the payoff function V on the reduction parameter a and, hence, on trade policy $\boldsymbol{\tau}$ is made explicit. V_0^r denote threat points, which are the payoff levels that would result if the negotiations break down. In its generalized form, the exponents of the Nash product α^r describe separate parameters to depict the market power of a region. As a result, the negotiation pins down a single reduction parameter $\tilde{a}$.

To calibrate the model, we use GTAP 6.1 data set with a base year of 2001, see Dimaranan (2006). The base year is well suited to describe the situation of the Doha Round, the moment where most coalitions entered the stage of the WTO. The comprehensive data set includes consistent social accounting matrices (SAM) of 87 regions with 57 sectors and 5 production factors. A special feature of the 6.1 data base is the largely revised protection data which were drawn from the MAcMap-HS6 database.[7] Starting at the detailed HS6 level, all available information on trade agreements and trade preferences are accounted for, see Bouët et al. (2008). Furthermore, extensive information on diverse national policy measures and transportation costs are contained in the GTAP data base. Since running the model at the most disaggregated level is costly and not constructive, we use a suitable sectoral and regional aggregation, see Tables 5 and 6 in the appendix. At the end, we arrive at an aggregation with 26 regions and 22 sectors. This is still a highly disaggregated model – especially in the agricultural sector – which allows us to give a broad picture of tariffs that would be obscured by using a more aggregated version.

3 Results and discussions

In this section, we highlight the potential role of developing countries coalitions in the context of the CGE model. First, a benchmark scenario is established where it is assumed that formation of coalitions is not possible. In a second step, we introduce several coalitions and analyse their consequences against our benchmark scenario. Finally, we take a deeper look into equity and efficiency considerations that result from various coalitions.

[6] The axioms proposed by Nash (1953) are: symmetry, efficiency, irrelevance of irrelevant alternatives and invariance to equivalent payoff representations.

[7] The Market Access Map (MAcMap) database consists of information gathered from COMTRADE, TRAINS and WTO.

3.1 The role of coalitions

To model the bargaining problem we need to identify the defining elements of the game first. Therefore, we begin with describing the relevant players, their payoffs and threat points. The identification of the actual players at WTO negotiations is involved, since in principle the official one-country-one-vote mechanism does not apply but the distribution of economic power plays a key role. Therefore, we assume that only countries/regions/coalitions with a share of at least one per cent in world trade are large enough to have a voice in the negotiations. This view is also supported by Schott and Watal (2000), whereas Bouët and Laborde (2010) employ a GDP threshold of four per cent. Using the trade share to define the watershed between participating and non-participating countries has the advantage that this figure condenses information on both, country size and comparative advantage. In Table 1, the trade share is shown together with the GDP and population shares, respectively. Only countries/regions/coalitions which exhibit a trade share that is larger than one per cent are listed. This implies that according to the one per cent trade share criterion, 12 countries/regions form the basis of WTO negotiations whereas with a four per cent GDP criterion only 3 countries/regions would take part. The former criterion seems to be better qualified to depict the situation during the Doha Round where significantly more countries were involved than the Triad regions (USA, EU15 and Japan). When it comes to the distribution of the gains from trade across regions, the exponent of the Nash product α^r plays a crucial role. In principle, one can think of a variety of proper measures such as GDP, population or trade weights. Whereas population shares would clearly benefit less developed countries/coalitions the opposite is true for a GDP type measure, see Table 1. In the following, we will focus on the trade share exponents but we will also briefly discuss the other measures. After having defined the relevant players (including coalitions) we formally introduce coalitions in the modelling framework by incorporating them into the set of regions in Eq. 2 accordingly.

As payoff V^r, we use the income of a representative agent in r and the threat point V_0^r is the income if the negotiations break down, i.e. the payoffs before the Doha negotiations. The relative difference between the actual payoff and the threat point $(V^r(a) - V_0^r)/V_0^r$ subject to the reduction parameter a is shown in Fig. 1. It can be indicated that the influence of across-the-board tariff reductions is quite heterogeneous across regions – and there are winners as well as losers. The multilateral liberalization seems to be especially beneficial for countries that are strong exporters of agri-food products like New Zealand, Indonesia, Thailand, Brazil or Turkey. They benefit from liberalization of relatively high agricultural protection. The losers are mainly developing and least developed countries which suffer from preference erosion that is associated with multilateral trade liberalization.

This very stylized set-up allows us to take a deeper look into the question how coalitions might affect outcomes at international tariff negotiations. It is also the first attempt to endogenously determine the outcome of multilateral tariff negotiations using a fine grid of reciprocal tariff reductions. However, there are some limitations to mention here. During trading rounds, a lot of different topics are negotiated at the same time. Issues such as trade facilitation measures, investments, competition,

Table 1 Description. GTAP 6.1; values in %

	Australia	Brazil	Canada	China	EFTA	EU15	Japan	KoreaTw	Mexico	Thailand	USA	Cairns	G-90	LDC
Trade share	1.0	1.0	3.6	4.7	2.3	36.3	6.2	4.3	2.2	1.0	15.5	6.0	1.8	1.0
GDP share	1.1	1.6	2.3	3.7	1.4	25.4	13.4	2.3	2.0	0.4	32.2	3.9	1.5	0.7
Pop. share	0.3	2.8	0.5	20.7	0.2	6.1	2.1	1.1	1.6	1.0	4.5	15.5	13.5	11.3

Source: GTAP 6.1; values in %

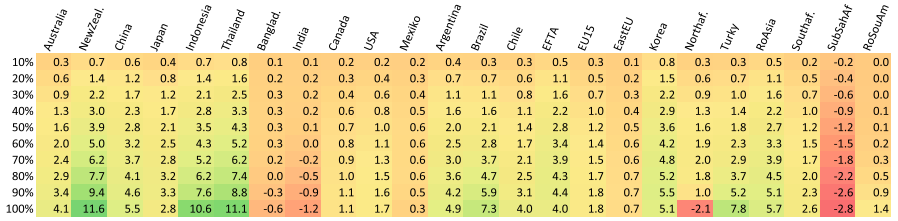

Fig. 1 Threat point adjusted payment changes (in %)

Table 2 No-coalition results, in %

	Weights			
	Equal	Pop.	GDP	Trade
$(1-a)*100$	92.2	100.0	93.9	93.5
Income change	2.07	2.07	2.09	2.08

environmental aspects or TRIPS are part of the trade talks, complicating the negotiations further. We focus only on tariff reductions which is an important issue of GATT/WTO negotiations. By changing only one thing at a time and holding all other things equal has the advantage that the single effect of tariff liberalization can be delineated from our study. This complexity reduction comes, however, at the cost of comprehensiveness. Another caveat is that tariff reductions themselves are more complex than described here. Tariffs are cut in various ways depending on the type of good or sector. Sectoral approaches in the form of sectoral differentiated formulae or zero-for-zero negotiations outside the scope of formulas have been proposed in the Doha Round. For example (sensitive) agricultural goods are treated differently than non-agricultural goods and services in the negotiations. In addition, we focused on a linear type tariff cutting formula only. In reality there are different formulas used and proposed. The Swiss formula, where high tariffs are cut by relatively more than small tariffs, is one of the most widely used, besides the linear formula. Recalculation of Nash bargaining solutions replacing the linear formula with the Swiss formula does not qualitatively change the results. The same is true when changing the assumption for bargaining power parameters in Nash product. For a detailed description of the modalities of the Doha negotiations also compare the extensive overview of VanGrasstek (2013). Given the caveats mentioned above, we believe, however, that this analysis reveals some interesting results that would also result in a more general setting.

3.1.1 No-Coalition scenario

Before we start with the analysis of the influence of coalitions on international tariff negotiations, we have to find a relevant benchmark against which to evaluate the appearance of coalitions. Therefore, in accordance with Bouët and Laborde (2010), we look at a (hypothetical) negotiation outcome that would result in a

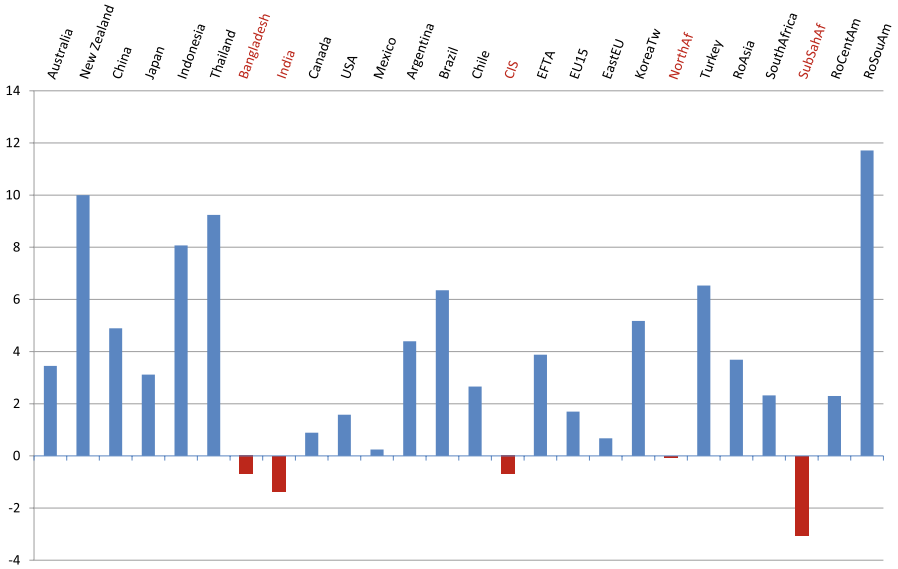

Fig. 2 Income changes of benchmark, trade share weight, in %

no-coalition world. The bargain outcome can be inspected in Table 2 for different types of bargaining power α^r. Depending on the assumption about the bargaining power, there will be across-the-board tariff cuts in the range of 92.2 and 100 %. Apparently, there is a non-linear relationship between a and the income change of all WTO countries. Whereas the population weight leads to free trade, a higher income change can be generated with a GDP type weight with significant lower tariff reductions.

Whereas the sum of income change of all WTO members is about 2 %, there is a high diversion among member states. By construction of the Nash bargaining approach all countries that are actively participating are gaining relative to their threat point. There are also other regions that have no voice at the bargaining table which have strong positive income effects like New Zealand or Rest of South America. By contrast, a few other countries – mostly developing and LDCs – are losing from the negotiations as can be seen in Fig. 2. Those regions would clearly use their veto right if they had enough power to influence the negotiations. In order to gain more voice, they have to ally with other countries and form a coalition. The situation for the other negotiations weights is depicted in Table 7 in the appendix. For most countries, the choice of weights does not matter much. But for some regions, in particular in regions that do not participate in the bargaining process, it can make a difference. North Africa for example would loose 2.5 % of income with a population weight due to larger preference erosions, while it would gain 0.2 % with equal weights.

Having identified the (benchmark) no coalition situation, we are now in the position to shed more light on the effect of coalitions in the next subsection.

Table 3 Coalition results, trade share weight, in %

	Coalitions		
	Cairns	G-90	LDC
$(1-a)*100$	94.7	63.0	0.0
Income change	+0.01	− 0.51	− 2.04

Changes relative to no-coalition scenario (benchmark)

3.1.2 Coalition scenarios

Because of structural constraints and lack of bargaining power, it is hard especially for small and least developed countries to get heard at international trade talks.[8] Participating in or building new alliances with other countries is an obvious strategy for those marginalized countries to escape their insignificance at the multilateral bargaining table.

According to the literature, coalitions can be divided in three non-selective categories. First, there are *issue-based coalitions* like G-10, G-20, G-33 or the Cairns Group who focus on agriculture or the NAMA-11 or the Friends of Ambition Group whose focus is on non-agricultural products. There are even more specific issue-based groups like the Friends of Fish (FoFs) or the Cotton-4 Group. Second, there are *like-minded groups* which share similar characteristics in terms of GDP or trade volume. Among them are the LDC Group, G-90 or the Group of Small Vulnerable Economies (SVE). Third, there are *region-based groups* like the African Group or the African, Caribbean, and Pacific (ACP) Group.[9].

We will not consider all coalitions mentioned above in the subsequent analysis for several reasons. First, some coalitions are simply to small in terms of our threshold criterion, like the Cotton-4 or the SVE Group. Second, some coalitions are very similar in their representations like the African and ACP Group and the G-90, so it is not instructive to show the results for all of them. Third, tariff preferences of the G-20 for example are quite similar to the Cairns Group and, thus, the results are excluded since they are basically indistinguishable from the Cairns Group results. Instead we will focus on the LDC Group, representing only least developed countries, the G-90 a mixture of least developed and developing countries, and the Cairns Group which consists mainly of developing and some developed, agri-food exporting countries.

The broad results of the apparition of coalitions at the bargaining table are depicted in Table 3 below. Since the results would not qualitatively change with respect to choice of bargaining power weights, as can be seen from Table 8 in the appendix, we focus on results where bargaining power is represented by trading weights in the text. The figures reveal some interesting results. Participation of the Cairns Group will result in more liberalization compared to the no-coalition case. This will lead to tariff reductions of 94.7 % compared to 93.5 % in the no-coalition scenario. This is because of the large gains from trade of the agri-food exporting

[8] Due to their small economic size least developed countries often even lack representation at the WTO in Geneva.

[9] A detailed list of coalitions is provided by the WTO, see: https://www.wto.org/english/tratop_e/dda_e/negotiating_groups_e.htm.

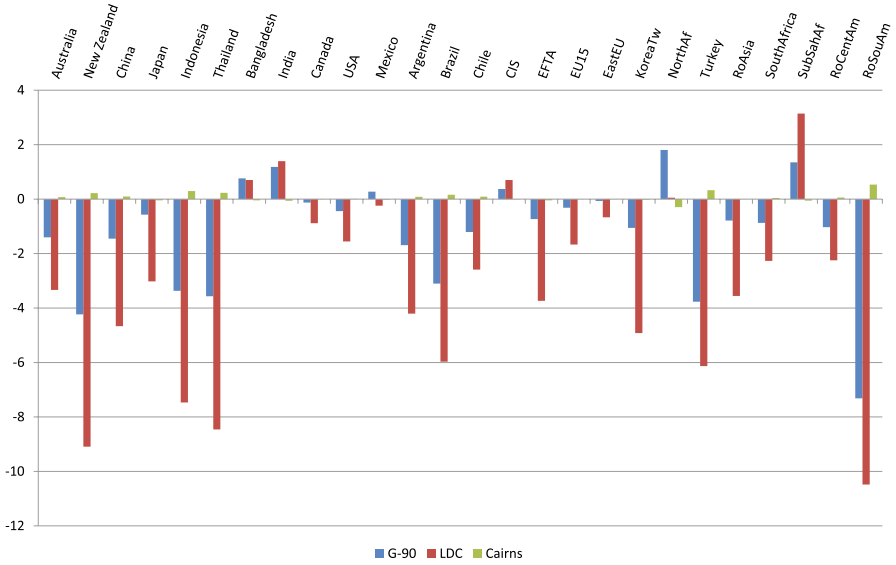

Fig. 3 Income changes of coalitions relative to benchmark, trade share weight, in %

countries that are more pronounced the lower *ex post* agri-food tariffs are. The effect on income is, however, close to zero.

The G-90 and the LDC Group have more opposing interests than the more developed countries, since they will suffer from preference erosions that are accompanied by multilateral liberalization efforts. This is mirrored in higher tariff formula parameters compared to Cairns and benchmark scenario. Whereas the G-90 will succeed in reducing overall liberalization to 63 %, the LDC Group will grind the negotiations to a halt. The G-90 coalition will reduce the total income by 0.5 %. The LDC Group would have the most severe influence on the bargaining results by reducing total income of the representative agent by more than 2 %.

In Fig. 3, the distribution of the payoffs across regions is shown for different coalition scenarios. Each coalition member benefits from participation with more pronounced effects for the LDC and G-90 members relative to the Cairns members. While there are some free-riders from LDC and G-90 coalition formation like India and CIS countries, most other countries stand to lose a lot of income. The correlation of income changes between Cairns on the one hand and LDC and G-90 on the other hand is negative, emphasizing their opposing interests.[10]

3.1.3 Efficiency and equity considerations

In this section we turn to equity and efficiency considerations. As already mentioned, developing countries coalitions are generally seen as a stumbling block to

[10] As in Bouët and Laborde (2010), we find that the G-90 coalition is beneficial for Sub-Saharan Africa and Bangladesh.

Table 4 Equity vs efficiency, trade share weight, in %

	Coalitions		
	Cairns	G-90	LDC
Change in income (efficiency)	+ 0.01	− 0.51	− 2.04
Change in Theil index (equity)	− 0.04	+ 0.21	+ 0.52

Changes relative to no-coalition scenario (benchmark)

more liberalization and, hence, as an obstacle to more efficient outcomes. On the other hand coalitions give especially less developed countries a voice in the negotiations which should improve their outcome relative to the outsiders which may also lead to a more equal distribution of gains from trade. We try to shed light on both issues in a systematic way given our modelling framework. Specifically, we will complement the efficiency aspects already brought up in the previous section with an adequate inequality measure. Efficiency is measured as total income and equity is given by the Theil index. The index is defined as

$$T = \frac{1}{R}\sum_{r}^{R}\frac{y_r}{\bar{y}}\ln\left(\frac{y_r}{\bar{y}}\right) \tag{3}$$

where y_r denotes income for region r and $\bar{y}$ the mean of y_r for all R regions. It ranges between 0, which indicates an equal distribution, and ∞. In general different ways to measure inequality exist. Both the Gini coefficient and Theil's index are frequently employed in the context of globalization, see Bourguignon and Scott-Railton (2015) for a recent application. From a conceptual basis both measures satisfy the criteria of mean independence, population size independence, symmetry and Pigou-Dalton Transfer sensitivity and are equally suitable for our purpose, see e.g. Haughton and Khandker (2009) for a more extensive review of different types of inequality measures. The changes of the Theil index are shown in Table 4 together with the changes in total income for the coalitions considered in this study. There are basically three interesting results that can be derived from this Table and that need to be commented: first, purely LDC and developing countries coalitions lead to more inequality. Second, we find a positive relationship between equity and efficiency. Third, given the small changes of the Cairns Group on income it is not surprising that the effects on equity are close to zero as well.

Interestingly, the Theil index is increasing for the G-90 and the LDC coalition, indicating a less equal distribution. This initially puzzling result may be explained by the fact that although many developing countries are gaining income (mostly African countries) in this scenario, there are also many developing countries which stand to loose a lot (e.g. Asian and South- and Central American countries), see Fig. 3. On the other hand, the negative change in the Theil index for the Cairns Group implies a more equal distribution when this coalition appears. Since the impact of this coalition is not so immense, there are no large disruptions especially in African countries and due to its broad coverage of Asian and South- and Central American countries the effect on equality is small but positive.

We can also identify a positive relationship between efficiency and equality. That means in the case of coalitions, there seems to be no trade-off between those two measures, which is in contradiction with the famous work by Okun (1975). Using aggregate income and its distribution across regions is of course a very broad and aggregate perspective on the trade-off, but it can be found quite frequently in international trade literature, see e.g. Freund (2017). Recently, political interest concerning the equity-efficiency nexus is increasing which has spurred research on this topic. Many studies now suggest a positive relationship between income and equality, see e.g. Ostry et al. (2014) and Brueckner and Lederman (2015). Although those studies rely on more comprehensive within-country inequality measures, they point to the same direction as our results.

4 Conclusion

The aim of this paper is to shed some light on the role of coalitions at international tariff negotiations by employing a standard CGE model augmented with Nash's bargaining concept. Specifically, the focus is on the equity-efficiency nexus associated with appearance of several coalitions. One finding is that the effects largely differ depending on the type of coalition we are looking at. The Cairns Group of agricultural exporters leads to more liberalization and more equality, whereas the opposite is true for the G-90 and the LDC Group. The LDC Group may be a game changer of the Doha Round in this setting, grinding the negotiations to a halt. This illustrates quite nicely the tensions between least developed and more developed countries described verbally in e.g. Narlikar (2005) in a quantitative setting. The analysis has also indicated that coalitions, while good for the members, largely reduce the income of the outsiders. Interestingly, purely LDC and developing countries coalitions (G-90 and LDC) impose big changes on the trading environment. While leading to more income in African LDC countries, this comes at the cost of high income losses in Asian and South and Central American countries which in turn leads to more inequality. Consequently, in this setting, developing countries can improve their position by forming coalitions. To spread these improvements amongst the developing world, however, there is a need for a grand coalition that includes all countries with side payments where the winners compensate the losers. Since the losers of large liberalization efforts exclusively consist of developing and least developed countries, this could for example be achieved by extending the 'Aid for Trade' initiative that is carried out by the WTO, as also suggested by Bouët and Laborde (2010). According to Evenett (2005), such a programme could compensate developing countries for preference erosions or losses in tariff revenue. In addition, transfer payments could be used for investments in educational and trade infrastructure.

Appendix

See Tables 5, 6, 7 and 8.

Table 5 Regional resolution

Region	GTAP Code	Coalition
Argentina	arg-Argentina	G-20 / Cairns
Australia	aus-Australia	
Bangladesh	bgd-Bangladesh	G-90 / LDC
Brazil	bra-Brazil	
Canada	can-Canada	
Chile	chl-Chile	G-20 / Cairns
China	chn-China	
CIS	rus-Russia, ukr-Ukraine, xsu-Rest of Former Soviet Union	
EFTA	che-Switzerland, xef-Rest of EFTA	
EU15	aut-Austria, bel-Belgium, dnk-Denmark, fin-Finland, fra-France, deu-Germany, gbr-UK, grc-Greece, irl-Ireland, ita-Italy, lux-Luxembourg, nld-Netherlands, prt-Portugal, esp-Spain, swe-Sweden	
EastEU	bgr-Bulgaria, hrv-Croatia, cze-Czech Republic, hun-Hungary, pol-Poland, rom-Romania, sck-Slovakia, svn-Slovenia, est-Estonia, lva-Latvia, ltu-Lithuania	
India	ind-India	G-20
Indonesia	idn-Indonesia	Cairns
Japan	jpn-Japan	
KoreaTw	kor-South Korea, twn-Taiwan	
Mexico	mex-Mexico	
NewZealand	nzl-New Zealand	Cairns
NorthAfrica	mar-Morocco, tun-Tunisia, xnf-Rest of North Africa	G-90
RoAsia	xea-Rest of Asia, mys-Malaysia, phl-Philippines, vnm-Vietnam, xse-Rest of Southeast Asia, lka-Sri Lanka, xsa-Rest of South Asia	Cairns
RoCentAm	per-Peru, ury-Uruguay, ven-Venezuela, xca-Central America, xcb-Rest of Caribbean, xap-Rest of Andean Pact	G-20 / Cairns
RoSouAm	xsm-Rest of South America	G-20
ROW	xoc-Rest of Oceania, hkg-Hong Kong, sgp-Singapore, xna-Rest of North America, col - Colombia, xer-Rest of Europe, xfa-Rest of FTAA, xme-Rest of Middle East	
SouthAfrica	bwa-Botswana, zaf-South Africa, xsc-Rest of South Africa Customs Union	G-20 / Cairns

Table 5 (continued)

Region	GTAP Code	Coalition
SubSahAf	mwi-Malawi, moz-Mozambique, tza-Tanzania, zmb-Zambia, zwe-Zimbabwe, mdg-Madagascar, uga-Uganda, xss-Rest of Sub-Saharan Africa	G-90 / LDC
Thailand	tha-Thailand	
Turkey	tur-Turkey	
USA	usa-United States	

'*CIS*' Commonwealth of Independent States, '*EFTA*' European Free Trade Association,

'*ROW*' Rest of the World, '*SubSahAf*' Sub-Saharan Africa, '*LDC*' Least Developed Countries

Table 6 Sectoral resolution

Sector Code	Description	GTAP Code
AgriInd	Food products, nec	ofd, vol
BevTob	Beverages and tobacco	b_t
Cereals	Cereals, nec	gro, wht
ChemInd	Chemical industry	crp, p_c
Dairy_prod	Milk and dairy products	mil, rmk
Electronic	Electronic	ome
LvstMeat	Livestock and meat	ctl, oap
MachInd	Equipment goods	omf, ome
Meat	Meat products	cmt, omt
MetalInd	Metal industry	fmp, i_s, nfm
OthCrop	Other crops, nec	ocr, osd, pfb
OthInd	Other industries	ely, nmm
OthPrim	Other primary products	coa, frs, fsh, gas, oil, omn, wol
Rice	Rice	pcr,pdr
Services	Services	cmn, cns, dwe, ele, gdt, isr, obs, ofi, osg, ros, trd, wtr
Sugar	Sugar	c_b, sgr
Textiles	Textiles	tex
TranInd	Transportation industry	mvh, otn
TransCom	Transportation	atp, otp, wtp
VegFruit	Vegetable and fruit	v_f
Wearing	Wearing apparel	lea, wap
WoodPaper	Wood and paper	lum, ppp

'*nec*' not elsewhere classified.

A more detailed description can be found on GTAP web site:

https://www.gtap.agecon.purdue.edu/databases/v6/v6_sectors.asp

Table 7 Income changes of benchmark, various weights, in %

	Equal	Pop.	GDP	Trade
Australia	3.37	3.89	3.48	3.45
New Zealand	9.74	11.39	10.08	10.00
China	4.80	5.68	4.92	4.89
Japan	3.15	2.62	3.10	3.12
Indonesia	7.77	10.50	8.17	8.07
Thailand	8.99	10.98	9.32	9.24
Bangladesh	– 0.65	–0.95	–0.71	–0.70
India	– 1.31	–1.73	–1.40	–1.37
Canada	0.89	0.85	0.89	0.89
USA	1.57	1.62	1.58	1.58
Mexico	0.27	0.08	0.23	0.24
Argentina	4.30	4.89	4.42	4.39
Brazil	6.17	7.32	6.41	6.35
Chile	2.57	3.26	2.69	2.66
CIS	– 0.68	0.78	0.70	0.69
EFTA	3.92	3.44	3.86	3.88
EU15	1.69	1.69	1.70	1.70
EastEU	0.67	0.65	0.67	0.67
KoreaTw	5.19	4.74	5.17	5.18
NorthAf	–0.22	–2.47	–0.14	–0.05
Turkey	6.18	8.79	6.65	6.53
RoAsia	3.68	3.67	3.69	3.69
SouthAfrica	2.28	2.53	2.33	2.32
SubSahAf	–2.99	–3.34	–3.06	–3.05
RoCentAm	2.24	2.66	2.32	2.30
RoSouAm	11.10	15.37	11.91	11.71

Table 8 Equity vs efficiency, various weights, in %

		Coalitions		
		Cairns	G-90	LDC
Trade	Efficiency	+0.01	–0.51	–2.04
	Equity	–0.04	+0.21	+0.52
GDP	Efficiency	+0.01	–0.33	–2.04
	Equity	–0.02	+0.16	+0.53
Pop.	Efficiency	0.00	0.42	–2.03
	Equity	0.00	+0.26	+0.59
Equal	Efficiency	+0.01	–0.41	–2.03
	Equity	–0.01	+0.17	+0.51

Changes relative to no-coalition scenario (benchmark)

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