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Tariff overhang and aid: Theory and empirics

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ABSTRACT

In this paper, we consider aid payments as a possible explanation for tariff overhangs. We set up a theoretical model in which rich countries use development aid to pay for tariff concessions by poorer countries. The more aid they receive as compensation, the more poor countries reduce the applied tariff below the bound tariff rate. Anticipating this mechanism, countries can negotiate a bound tariff rate that induces the joint optimal applied tariff and aid as outcomes. We empirically examine the relationship between tariff overhangs and donor aid preferences using detailed data on WTO members' bound and applied tariff rates under the Uruguay agreement. The data sample contains a predominant majority of WTO members that are aid recipients under the Uruguay agreement. Our results provide support for the model's aid-for-trade mechanism.

1. Introduction

Most world trade takes place under WTO (and former GATT) regulation: 75 percent of all countries are members of the organization and a further 11 percent are under observation to acquire membership. Almost all tariffs are thereby subject to regulation set in multilateral trade negotiations. The high participation in multilateral agreements reflects the success of the multilateral trade negotiation system in liberalizing world trade. Thus, it may be surprising that many countries, especially in the developing world, have committed to tariff ceilings, so-called "tariff bounds", which exceed applied rates on most products (see, e.g., WTO, 2018).

This observation of a positive "tariff overhang" is difficult to reconcile with standard theoretical hypotheses on incentives for governments in trade negotiations. If special interest pressure determines protection, tariff outcomes of trade negotiations reflect the stakes of domestic and foreign industries (Grossman and Helpman, 1994). If tariffs arise from a motivation of manipulating the terms-of-trade to reap unilateral trade gains, trade negotiations can result in an internalization of these terms-of-trade externalities (Bagwell and Staiger, 1999). In both cases, there seems to be no reason to negotiate bound tariffs that exceed applied tariff rates in noncooperative equilibrium.

The negotiation of tariff ceilings instead of actual tariff rates can be explained, however, if additional factors are taken into account. If interest group pressure influences domestic tariff policies and if capital is inter-sectorally mobile, governments can opt for tariff bindings to counteract investment distortions (Maggi and Rodríguez-Clare, 2007). Other reasons for negotiating tariff ceilings are contracting costs under uncertainty (Hausmann et al., 2007) or a trade-off between commitment in negotiations and flexibility to respond to future changes in political pressure by special interests under the agreement (Bagwell and Staiger, 2005). The tariff overhang is lower under higher importer market power because of stronger enforcement to reduce the tariff bound in negotiations and a starker terms-of-trade improvement of applied tariff protection (Beshkar et al., 2015).

In this paper, we examine an explanation for tariff bounds that hinges on the fact that developing countries are over-represented in the use of tariff overhangs and regularly adopt larger tariff overhangs than other countries. According to our hypothesis, development aid may serve as an instrument to influence tariffs of developing countries. Rich countries may buy access to poorer countries' markets by promising aid payments in return for tariff concessions. This also affects the preceding bound tariff negotiations such that a tariff overhang is induced. We empirically examine this hypothesis using detailed data on WTO members' bound and applied tariff rates under the Uruguay agreement. Our country sample includes a predominant majority of aid recipients that were WTO members at the time.

The rest of this paper is structured as follows: In the next section, a description of related studies is provided to place our contribution in perspective. A theoretical model that illustrates main mechanisms at work is presented in Section 3. A data description is given in Section 4

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[1] Both authors have contributed to this work and take public responsibility for the content. The research performed is unique to the paper and the contribution will not be reused elsewhere.

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and the empirical investigations are presented in Section 5. The last section concludes.

2. Background

Market power is a central feature of multilateral trade negotiations. A classic argument for tariff protection is that the government of a country with market power can restrict imports to improve its terms-of-trade. As this argument also holds for the foreign trading partners as well, countries are likely to set tariffs at inefficiently high levels, incurring losses in noncooperative equilibrium. Governments acting under social welfare motives may therefore forge international trade agreements to enforce mutual tariff reductions. Two pillars of the multilateral trade negotiation system counteract terms-of-trade manipulation: the non-discrimination principle and the reciprocity principle (Bagwell and Staiger, 1999). Empirical evidence shows that elasticities of foreign export supply affect tariff rates that are not subject to WTO regulation (Broda et al., 2008) so that larger tariff cuts are incurred upon WTO membership if importer market power is stronger (Bagwell and Staiger, 2011). However, protectionism to raise the terms-of-trade may not be eliminated by the multilateral trade negotiation system due to various reasons: exceptions from non-discrimination in its regulatory framework (Bagwell and Staiger, 1999), free riding of exporters with low stakes on the most-favoured-nation tariff (Ludema and Mayda, 2013),[2] and weakly binding MFN tariffs (Beshkar et al., 2015; Nicita et al., 2018).

That industry-specific interests may influence tariff outcomes is well established in the political-economy literature.[3] Governments may take into account interests of the import-competing industry in addition to implications for the aggregate welfare of their constituency. The resulting tariff rate is higher at a less elastic import demand due to limited deadweight loss, and it is higher at a larger ratio of domestic output to imports because of larger gains at stake of industry-specific interests and lower welfare costs (Grossman and Helpman, 1994).[4] In large countries, the tariff rate is also higher at a less elastic foreign export supply due to the additional incentive to manipulate terms-of-trade (Grossman and Helpman, 1995). While the terms-of-trade effect can be neutralized by effective negotiation, the uneven political influence of interest groups is certain to filter into the agreement. A higher negotiated tariff rate results if industry interests in the importing country exert stronger political power over their government compared to corresponding interests in the exporting country.

Governments can opt for negotiating tariff ceilings instead of actual tariff rates to ensure that they have the discretion to respond should shocks appear that affect policy-making constraints.[5] Tariff ceilings enable governments to levy lower tariffs and to incur higher national welfare in the absence of such events. Contracting costs can be important in explaining the negotiation focus on tariff ceilings under uncertainty about future conditions (Horn et al., 2010). Bagwell and Staiger (2005) and Amador and Bagwell (2013) model the trade-off between allowing governments to react to the political influence of special interests and restricting the ability to manipulate the terms-of-trade. They show how a tariff ceiling may arise endogenously from this trade-off. A tariff ceiling also preserves the political influence of industry interests and reduces the net returns from influencing the negotiation, which counteracts inefficiencies arising from a distorted allocation of capital (Maggi and Rodríguez-Clare, 2007).

Tariff overhang reflects flexibility in policy making, which is utilized because the future political influence of import-competing producers is uncertain (Bagwell and Staiger, 2005). Policymakers face political uncertainty as the demand from the import-competing industry varies over time. Governments in countries where this variability is higher are thereby expected to implement larger tariff overhangs. The tariff overhang decreases with importer market power as the terms-of-trade externality of protection stimulates negotiation partners to exert more effort to reduce the bound rate and leads to a higher applied tariff rate under the agreement (Beshkar et al., 2015). Additionally, the gains from negotiating binding tariff reductions compared to contracting costs are increasing in importer market power (Nicita et al., 2018).

The relationship between foreign aid and tariffs of recipient countries has been analysed before. To our knowledge, however, none of the existing literature deals with its implications for tariff bindings. In Lahiri and Raimondos-Møller (1997), aid increases demand for goods exported by the donor. Due to this effect, the donor country allocates more aid to a recipient country that has a low tariff rate. Lahiri et al. (2002) extend this analysis allowing the donor country to commit to aid payments that are contingent on subsequently set tariff rates by the recipients. Nanivazo and Lahiri (2015) analyse the implications of conditional aid that is given as a prize depending on the tariff policy of recipient countries.

3. The model

Our model characterizes in stylized form international trade agreements between developed and developing countries, incorporating voluntary foreign aid payments. We consider two countries, one in the North (denoted by N) and one in the South (denoted by S). Country N exports a final good to country S on which the government in S may set an import tariff with tariff rate $\tau \geq 0$. The government in N can pay development aid $a \geq 0$ to country S. To focus on the relationship between aid and tariffs in the South, we neglect import tariffs that could be raised by country N and focus entirely on imports by S.

The model comprises two stages: In the first stage, countries cooperatively set a bound tariff rate τ^b, while the applied tariff rate τ^a as well as the level of aid a given in concession to tariff reductions are determined in the second stage. In this second stage, country N can give aid conditional on the applied tariff rate implemented by country S. Thereby, it can induce country S to reduce the applied tariff rate below the existing bound rate. In the first stage, governments maximize joint welfare.[6] In the second stage, country N maximizes its own welfare given that it needs to compensate country S for any tariff concessions by paying aid. It should be noted that we do not discard other reasons for aid but simplify the model presentation by normalizing $a = 0$ without tariff overhang. If other forms of aid, such as immediate disaster relief, would be included, this would not change the model predictions we bring to the empirics.

The political objectives of the government in N and of its trading partner in S with regard to the tariff are given in reduced form by $V^N(\tau)$ and $V^S(\tau)$. These objective functions can be interpreted as representing aggregate welfare incorporating political economy elements as outlined in the preceding discussion of the literature. Both objective functions are twice differentiable. $V^N(\tau)$ monotonically decreases in the tariff rate τ, i.e., $V^N_\tau(\tau) < 0$. $V^S(\tau)$ first increases for low levels of τ and has an interior maximum for a tariff rate that is strictly positive and

[2] Recent evidence by Ludema et al. (2019) indicates that the latter effect has been counteracted by the formation of preferential trade agreements, pointing to a building-block effect of preferential trade liberalization.

[3] See, e.g., Hillman (1982) or Grossman and Helpman (1994). For an application of the Grossman–Helpman model to a developing country context, see Mitra et al. (2002).

[4] More recently, the empirical relevance of this hypothesis has been placed under scrutiny by Imai et al. (2009, 2013), who show that testing the model using quantile regressions overturns its support and uncovers a positive link between protection and import penetration.

[5] In a related setting, Busch and Pelc (2014) compare the use of tariff bindings to that of trade remedies in the WTO.

[6] In this partial equilibrium setting, joint welfare maximization implicitly assumes that countries have the possibility to transfer welfare between them using lump-sum payments.

below the prohibitive level. This optimum tariff is denoted by $\tau^o > 0$, i.e., $V_\tau^S(\tau^o) = 0$. Due to the negative spillover of the tariff to the exporting country, the tariff rate that maximizes joint welfare of both countries is accordingly lower than τ^o. With τ^* denoting this joint optimal tariff rate, $\tau^* < \tau^o$. The respective second order conditions for τ^o and τ^* require $V_{\tau\tau}^S(\tau^o) < 0$ and $V_{\tau\tau}^S(\tau^*) + V_{\tau\tau}^N(\tau^*) < 0$, which are assumed to be satisfied.

Aid payments are beneficial for country S and costly for country N. Welfare including aid is given by $W^S(\tau, a) = V^S(\tau) + a$ for country S and by $W^N(\tau, a) = V^N(\tau) - C(a)$ for country N. $C(a)$ denotes the costs of paying aid for N, which are assumed to be increasing and strictly convex in a, i.e., $C_a(a) > 0$ and $C_{aa}(a) > 0$. This cost function not only accounts for the direct costs and potential excess burden from financing aid, but it represents all aspects that may be relevant for the donor country in its assessment of aid payments (apart from its effects on the applied tariff). In particular, a donor government can have political or strategic motives to pay aid to certain recipient countries in the South (see, e.g., Alesina and Dollar, 2000). To explicitly consider the strength of these motives, we include a preference term γ that influences the costs of paying aid, i.e., $C = C(a, \gamma)$. A higher γ stands for stronger political motives to pay aid to country S resulting in lower (but still positive) marginal costs of aid: $C_{a\gamma} < 0$. The joint optimal level of aid a^* is given by $C_a(a^*) = 1$. In the optimum, the marginal costs of aid for country N are equal to the marginal benefits of 1 for country S. For such an optimum with a positive aid level to exist we assume $C_a(0) < 1$.

3.1. Applied tariff rate and aid payments

For the second stage of the model, we consider the situation in which a bound tariff has been set with a tariff rate $\tau^b < \tau^o$. Country S can introduce an applied tariff rate τ^a below this bound rate. Country N, in turn, can give aid to S conditional on the applied tariff. That is, N offers to pay a but only if S sets τ^a to a certain level. In order to induce S to accept the suggested applied tariff, its incentive compatibility constraint (icc) has to be satisfied:

$$a = V^S(\tau^b) - V^S(\tau^a) \,. \tag{1}$$

The icc(1) specifies a negative relationship between the aid payment and the applied tariff rate. If N asks for a larger tariff concession by S, it has to pay more aid as compensation. This relationship is depicted by the negatively sloped icc-curve in Fig. 1, and it follows analytically from differentiating (1):

$$\frac{da}{d\tau^a}\Big|_{icc} = -V_\tau^S(\tau^a) < 0 \,. \tag{2}$$

Country N sets a and τ^a to maximize its welfare $V^N(\tau^a) - C(a)$ subject to $a = a(\tau^a)$ as determined by (2). The first order condition (foc) for the North in this setting can be written as

$$V_\tau^N(\tau^a) + C_a(a) \cdot V_\tau^S(\tau^a) = 0 \,. \tag{3}$$

Given that an interior solution with $\tau^a \geq 0$ exists, Eq. (3) determines the North's optimal applied tariff given constraint (1). According to (3), the applied tariff rate depends on the aid level a: The tariff rate equals the joint optimal rate if aid is set at the joint welfare maximizing level, i.e., $\tau^a = \tau^*$ for $C_a(\cdot) = 1$. If aid payments are higher (lower) than this first best level, the tariff rate exceeds (falls short of) the joint optimal rate. In Fig. 1, the curve foc depicts the relationship between a and τ^a that follows from the first order condition. The slope of this curve can be obtained by differentiating (3):

$$\frac{d\tau^a}{da}\Big|_{foc} = -\frac{C_{aa}(a) \cdot V_\tau^S(\tau^a)}{V_{\tau\tau}^N(\tau^a) + C_a(a) \cdot V_{\tau\tau}^S(\tau^a)} \,. \tag{4}$$

We assume that the denominator of (4) is negative, which holds in any case if a is equal to a^* and $\tau^a = \tau^*$. The foc curve is then positively sloped, i.e., the optimal applied tariff rate increases in the aid level (see Fig. 1).

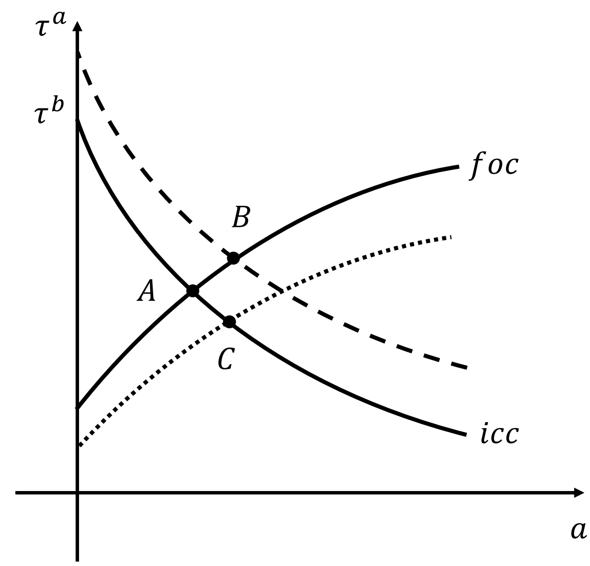

Fig. 1. Applied tariff rate and aid level.

Together, both Eqs. (1) and (3) jointly determine the optimal applied tariff rate and the resulting aid level in the second stage of the model, Graphically, the intersection of both curves in Fig. 1 specifies this optimum (point A). Our assumption concerning the denominator of (4) is sufficient for the second order condition, $V_{\tau\tau}^N(\tau^a) + C_a(a) \cdot V_{\tau\tau}^S(\tau^a) - C_{aa}(a) \cdot \left(V_\tau^S(\tau^a)\right)^2 < 0$, to be satisfied.

The influence of the tariff binding on the equilibrium applied rate is given by a comparative static analysis of conditions (1) and (3). An increase in the bound tariff rate τ^b shifts the icc-curve upwards in Fig. 1 (to the dashed line), resulting in an increase in the applied rate as well as in the aid level at the new intersection (point B). Due to the increase in aid, the applied tariff rate increases by a smaller amount than the bound rate, such that the tariff overhang $\tau^b - \tau^a$ increases in the bound rate (an analytical derivation is provided in Appendix A).

If the preference term γ in the aid cost function increases, country N is willing to give more aid to S. With these higher aid payments, in turn, country N can get larger tariff concessions from country S and the applied tariff rate declines. In Fig. 1, an increase in γ shifts the foc curve to the right (to the dotted line), such that the optimum moves from point A to point C (see Appendix A for a derivation). Lemma 1 summarizes the results obtained so far.

Lemma. *Suppose, the bound tariff rate τ^b is given with $\tau^b < \tau^o$. An increase in the level of aid implies a larger tariff overhang. In an interior equilibrium with $a > 0$ and $\tau^a > 0$, a change in τ^b or in the preference term γ has the following influence on the applied rate and on the aid level:*

$$0 < \frac{d\tau^a}{d\tau^b} < 1 \,, \quad \frac{d\tau^a}{d\gamma} < 0 \,, \quad \frac{da}{d\tau^b} > 0 \,, \quad \textit{and} \quad \frac{da}{d\gamma} < 0 \,.$$

3.2. Tariff binding

In the first stage of the model, governments jointly set the bound rate τ^b to maximize $V^S(\tau^a) + V^N(\tau^a) + a - C(a)$ taking into account the influence of the bound rate on the outcome in the second stage, i.e., $a = a(\tau^b)$ and $\tau^a = \tau^a(\tau^b)$.[7] The first order condition for the optimal bound rate can be written as follows:

$$\left[V_\tau^N(\tau^a) + V_\tau^S(\tau^a)\right] \cdot \frac{d\tau^a}{d\tau^b} + \left[1 - C_a(a)\right] \cdot \frac{da}{d\tau^b} = 0 \,. \tag{5}$$

[7] In a more general framework with North and South tariffs, the tariff negotiations could involve reciprocal tariff reductions to achieve a joint welfare improvement. However, there would still be an incentive to retain a certain tariff overhang by country S in return for aid from country N.

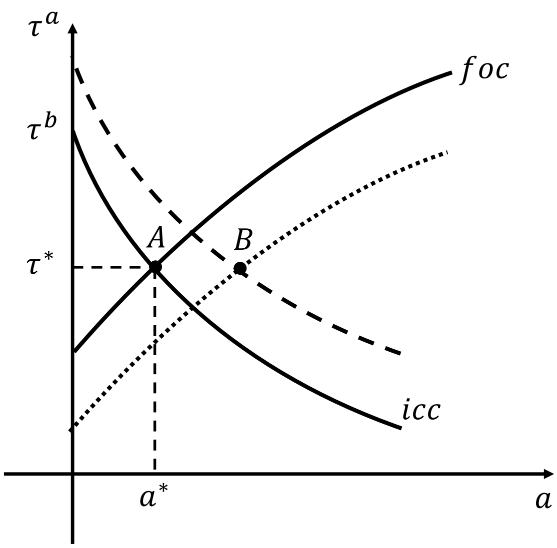

Fig. 2. Optimal tariff binding.

Inserting from (3) and rearranging yields:

$$\left[V^N_\tau(\tau^a)+V^S_\tau(\tau^a)\right]\cdot\left[\frac{d\tau^a}{d\tau^b}+\frac{1}{V^S_\tau(\tau^a)}\cdot\frac{da}{d\tau^b}\right]=0\,. \tag{6}$$

This condition is satisfied if $V^N_\tau(\tau^a)+V^S_\tau(\tau^a)=0$ or $\tau^a=\tau^*$. In the first stage, governments can use their strategic position to implement the first best optimum. They set the bound tariff rate at a level above the joint optimal tariff rate ($\tau^b>\tau^*$) such that there remains an incentive to pay the desired level of aid $a=a^*$ in the second stage and to reduce the applied tariff voluntarily to the optimal rate.[8] This outcome is illustrated in Fig. 2. The bound rate is chosen such that the resulting *icc* curve cuts the *foc* at point A with $\tau^a=\tau^*$ and $a=a^*$.

Analytically, Eq. (1) has to be satisfied with $a=a^*$ and $\tau^a=\tau^*$. This conditions the optimal bound rate via

$$V^S(\tau^b)=V^S(\tau^*)+a^*\,. \tag{7}$$

The bound tariff has to be set such that it delivers the same welfare level to country S as the joint optimum with aid. As the welfare of country S is maximized at τ^o, condition (7) can only be satisfied if

$$V^S(\tau^o)>V^S(\tau^*)+a^*\,. \tag{8}$$

Otherwise, governments cannot achieve the joint welfare maximum by setting the bound rate below the optimum tariff.[9] In this case, τ^b would be equal to τ^o and the applied tariff τ^a resulting from (1) and (3) would be lower than the joint optimal rate τ^*. The following proposition summarizes these results.

Proposition. *Suppose, τ^a and a are determined by (1) and (3) and that governments set τ^b to maximize joint welfare. If condition (8) is satisfied, the optimal bound rate τ^b implies $\tau^a=\tau^*$ and $a=a^*$.*

An increase in the preference term γ raises the bound rate according to the following equation:

$$\frac{d\tau^b}{d\gamma}=-\frac{d\tau^a/d\gamma}{d\tau^a/d\tau^b}>0\,, \tag{9}$$

since $d\tau^a/d\tau^b>0$ and $d\tau^a/d\gamma<0$. As the first best optimal aid level increases in γ while the optimal applied rate remains unchanged, governments negotiate a higher bound rate in the first stage to induce higher aid payments given the incentive compatibility in the second stage. In Fig. 2, an increase in the preference term shifts the *foc* curve to the right (dotted line) putting a downward pressure on the applied rate. To keep the applied rate at the original level, governments raise the bound rate such that the *icc* curve is shifted upwards, resulting in a new optimum in point B.

3.3. Political influence and market power

To illustrate our model and to obtain further comparative static results, we specify a simple partial equilibrium setting with inelastic supply and linear demand curves. Our specific assumptions yield a tractable framework to incorporate political influence of producer interests as well as importer market power as determinants of tariff policy. Demand for good q is given by $d^N=2-p^N$ in country N and by $d^S=n\cdot(2-p^S)$ in country S. Producers in S supply $q^S=n$ units of the good and producers in N supply $q^N=1+\delta$ units, with $0<\delta<1$.[10] The term n stands for the country size of S and δ denotes the size of the export industry of N. The tariff inserts a wedge between prices in S and in N, i.e., $p^S=p^N+\tau$. Equilibrium prices and imported quantities of S, $m^S=d^S-q^S$, are given by

$$p^S=1+\tilde{\tau}-\tilde{\delta}\,,\quad p^N=1-n\tilde{\tau}-\tilde{\delta}\,,\quad\text{and}\quad m^S=n\cdot(\tilde{\delta}-\tilde{\tau})\,, \tag{10}$$

with $\tilde{\tau}=\tau/(1+n)$ and $\tilde{\delta}=\delta/(1+n)$. Imports are positive in this setting as long as $\tau<\delta$.[11]

The objective function of country N with regard to the tariff in S is given by the sum of producer and consumer surplus, $V^N=PS^N+CS^N$:

$$V^N(\tilde{\tau})=\left(1-n\tilde{\tau}-\tilde{\delta}\right)\cdot\left[1+(1+n)\tilde{\delta}\right]+\frac{1}{2}\cdot(1+n\tilde{\tau}+\tilde{\delta})^2\,. \tag{11}$$

An increase in the tariff rate in S has the following effects on government objectives in N:

$$V^N_{\tilde{\tau}}=n^2\cdot\left(\tilde{\tau}-\tilde{\delta}\right)\,. \tag{12}$$

According to (12), $V^N_{\tilde{\tau}}(\tilde{\tau})$ is negative for all non-prohibitive $\tilde{\tau}$. The government in S considers producer surplus, consumer surplus and tariff revenues $T^S=\tau\cdot m^S$ in its objective function. As suggested by Baldwin (1987), we consider the political influence of import-competing producers by assuming that the government in S places a relatively larger weight on their surplus: $V^S=\theta\cdot PS^S+CS^S+T^S$, with $\theta>1$. To obtain an interior solution for the joint optimal tariff τ^*, we furthermore restrict the political weight to $\theta<1+\delta$. After inserting from (10), we obtain

$$V^S(\tilde{\tau})=\theta\cdot n\cdot\left(1+\tilde{\tau}-\tilde{\delta}\right)+\frac{n}{2}\cdot\left(1-\tilde{\tau}+\tilde{\delta}\right)^2+n\cdot(1+n)\cdot\tilde{\tau}\left(\tilde{\delta}-\tilde{\tau}\right)\,. \tag{13}$$

The marginal influence of the tariff rate on $V^S(\tilde{\tau})$ is given by

$$V^S_{\tilde{\tau}}(\tilde{\tau})=n\cdot\left(\theta-1-(1+2n)\cdot\tilde{\tau}+n\cdot\tilde{\delta}\right)\,. \tag{14}$$

$V^S(\tilde{\tau})$ is first increasing and then decreasing in $\tilde{\tau}$ and yields the following optimum tariff rate for S:

$$\tau^o=\frac{(1+n)\cdot(\theta-1)}{1+2n}+\frac{n\delta}{1+2n}\,. \tag{15}$$

The first term of Eq. (15) reflects political motives to protect domestic producers, while the second term results from the terms of trade

[8] The next subsection shows for a specific model framework that an interior solution exists if the aid preference parameter γ is sufficiently small.

[9] This also implies that country S needs to be compensated if it enters the negotiations on the bound rate starting from the non-cooperative optimum tariff τ^o as fall-back option. In our model, such a compensation would imply ex ante transfers. In a more general setting in which N also raises tariffs, one could also think of tariff reductions by country N as compensation.

[10] By assuming an inelastic supply, we further simplify compared to related contributions, such as Bagwell and Staiger (2005), Beshkar et al. (2015), that consider linearly increasing supply curves. We do that for tractability reasons and to simplify the exposition. However, we expect that the main forces at work in our setting carry over to a more general framework with elastic supply.

[11] The price p^N is positive for all non-prohibitive tariff rates due to our assumption $\delta<1$.

influence of an increase in the tariff rate. The non-cooperative tariff rate τ^o increases in the political power of producers θ as well as in δ and n.

From the view of both countries together, the tariff rate that maximizes aggregate welfare $V^S(\tilde{\tau}) + V^N(\tilde{\tau})$ is determined by

$$\tau^* = \theta - 1 . \tag{16}$$

While for $\theta = 1$ free trade ($\tau^* = 0$) would be jointly optimal, the joint optimal tariff rate τ^* is strictly positive for $\theta > 1$. It increases in the political weight of the importer industry θ, whereas the market power parameters n or δ do not influence τ^*. With (16), the optimal tariff can also be written as

$$\tau^o = \tau^* + \frac{n}{1+2n} \cdot (\delta - \tau^*) . \tag{17}$$

Our parametric assumption $\theta < 1 + \delta$ implies $\tau^o < \delta$.

For the costs of giving aid for country N, we assume $C(a) = (1-\gamma)\cdot a + a^2/2$, with $0 < \gamma < 1$. The quadratic term in this specification yields increasing marginal costs of aid for N: $C_a = 1 - \gamma + a$. The joint optimal aid level is given by $a^* = \gamma$.

With $V^S(\tilde{\tau})$ given by (13), we can determine the aid level as a function of the applied tariff rate from the $icc(1)$:

$$a = \frac{n\cdot(1+2n)}{2(1+n)^2} \cdot \left(\tau^b - \tau^a\right) \cdot \left(2\tau^o - \tau^b - \tau^a\right) . \tag{18}$$

Furthermore, with (12) and (14), the applied tariff rate follows from the $foc(3)$ as

$$\tau^a = \tau^* + \frac{x}{1+x} \cdot (\delta - \tau^*) , \quad \text{with} \quad x = \frac{n\cdot(a-\gamma)}{(1+n)\cdot(1+a-\gamma)} . \tag{19}$$

The term x represents the influence of the aid level on the equilibrium applied tariff rate, which is positive. If aid is set at the joint optimal level ($a^* = \gamma$), then $x = 0$ such that $\tau^a = \tau^*$.

Together, Eqs. (18) and (19) yield the equilibrium values of τ^a and a in the second stage of the model for a given bound rate τ^b. The optimal bound rate, in turn, is set in the first stage such that $a = a^*$ and $\tau^a = \tau^*$. Inserting a^* and τ^* in condition (18) yields the following equation that determines the bound rate in the first stage of the model:[12]

$$(2\tau^o - \tau^b - \tau^*)\cdot(\tau^b - \tau^*) = \frac{2\gamma\cdot(1+n)^2}{n\cdot(1+2n)} . \tag{20}$$

From (18) and (19), we can derive the effects of an increase in the political influence term θ as well as in n and δ on the outcome in the second stage (see Appendix A). Suppose the bound rate is initially set at the optimal level such that $a = a^*$ and $\tau^a = \tau^*$. For a given bound rate τ^b, an increase in the political weight of producers raises the applied tariff rate and lowers the aid level:

$$\frac{d\tau^a}{d\theta} > 0 \quad \text{and} \quad \frac{da}{d\theta} < 0 .$$

The effect of θ on the aid level also determines how governments adjust the bound rate to an anticipated increase in θ. As the optimal level of aid $a^* = \gamma$ does not change in θ, governments raise the bound rate if the willingness to give aid rises. That is, τ^b increases in θ (see Appendix A):

$$\frac{d\tau^b}{d\theta} > 0 .$$

An increase in market size of S yields at $a = a^*$ and $\tau^a = \tau^*$ for a given bound rate (see Appendix A)

$$\frac{d\tau^a}{dn} > 0 \quad \text{and} \quad \frac{da}{dn} > 0 . \tag{21}$$

Similar effects can be derived for an increase in relative supply δ (see Appendix A):

$$\frac{d\tau^a}{d\delta} > 0 \quad \text{and} \quad \frac{da}{d\delta} > 0 . \tag{22}$$

[12] An interior solution for (20) exists if γ is not too large (see Appendix A).

For the influence of market size and supply on τ^b, we obtain (see Appendix A)

$$\frac{d\tau^b}{dn} < 0 \quad \text{and} \quad \frac{d\tau^b}{d\delta} < 0 . \tag{23}$$

An increase in n or δ size does not influence the joint optimal tariff τ^*. However, it induces country S to raise the applied tariff rate. To counteract this effect and to keep the applied rate at the joint optimal level, both countries reduce the bound rate ex ante in the tariff agreement. This explains the negative influence of the two market power parameters n and δ on the bound rate.

4. Data

To empirically examine our model, we analyse Uruguay agreement negotiations and outcomes. The data measurement is based on the determination of bound tariffs in the negotiations (stage 1) and applied tariffs with the agreement in force (stage 2). Bound tariff determinants are measured by 3-year means at the end (and thrust) of the country's negotiation of its Uruguay agreement terms, covering the 1992–1994 period for Uruguay round participants and 3-year periods leading up to WTO accession for new members. The Uruguay agreement was implemented in its entirety in 2005 and the subsequent Doha agreement negotiations were finalised in 2013. Applied tariff setting under the Uruguay agreement is examined based on 3-year variable means covering the 2005–2007, 2008–2010 and/or 2011–2013 periods depending on the use of tariff information (to determine the applied tariff or identify the aid-for-trade mechanism) and the country's WTO entry. Our periodization corresponds to 3-year replenishment periods used by the International Development Association (IDA),[13] which functions as a general guide in the aid programming of its donors (Galiani et al., 2017).

4.1. Tariffs

Our tariff data set comes from the UNCTAD TRAINS data base. The data is reported at the (6-digit) product level of the Harmonized System (HS) classification, which is the nomenclature used in GATT/WTO tariff negotiations. Uruguay agreement tariff data is matched with the HS1992 classification (using concordance tables from the UN Statistics Division) relevant at the time of finalising the Uruguay round.

The tariff overhang equals the gap, in percentage points, between the bound (BND) and most-favoured-nation (MFN) tariff rates.[14] Countries often do not use any of the leeway given by the tariff ceilings; zero MFN tariffs are adopted for almost 1 out of 5 products. Tariff bindings give governments considerable flexibility as displayed by the strong correlation between the tariff overhang and bound tariff rate ($\rho = 0.88$) and weak correlation between the tariff overhang and applied tariff rate ($\rho = 0.03$). Developing (non-OECD) countries are over-represented in the utilization of tariff overhangs. Bindings are weak (i.e., above applied tariffs) in 85 percent of their (product) import categories.

Uruguay agreement tariff statistics are reported in Table 1. The average tariff overhang is 28.1 percentage points, which implies that the applied tariff rate can be almost tripled (evaluated at the mean) without allowing for retaliatory response under WTO regulation. Developing countries use five times larger tariff overhangs, almost four times larger bound tariff rates and twice as large MFN tariff rates as developed countries. New members have much lower tariff overhangs than Uruguay round participants in their developing country category in line with prior evidence of stricter post-round negotiation conditions (Evenett and Primo Braga, 2006; Beshkar et al., 2015).

[13] The 14, 15 and 16 IDA replenishment was finalised in April 2005, December 2007 and December 2010.

[14] MFN tariffs are sometimes left unbound in the negotiations. For our purpose of studying an aid-for-trade game subject to regular (bound) tariff constraints, these cases are omitted from the empirical investigation. The restriction has negligible impact on the applied tariff level, which is almost identical ($\rho = 0.97$).

Table 1
Uruguay agreement tariff statistics.

Countries	Tariff overhang (p.p.)		BND tariff rate (%)		MFN tariff rate (%)	
	Mean	STD	Mean	STD	Mean	STD
All	28.1	27.3	38.2	29.7	9.7	5.0
Developed	6.0	7.3	10.7	10.2	4.7	3.9
Developing	30.7	27.8	41.5	29.7	10.4	4.8
New member	8.9	16.8	16.8	18.3	7.9	3.7

Note: Country-product means reported.

Tariff data reporting is contingent on product imports, implying that observed aggregate tariff levels depend on the import composition. To circumvent induced result bias, our tariff measurement hinges on regular product import flows.[15]

4.2. Aid and aid preference

Aid is measured using net official development assistance (ODA) data in natural logarithms of US Dollars. ODA is categorized as aid that meets the OECD Development Assistance Committee (DAC) standard (i.e., given for development purposes).[16] Data on ODA donations from DAC countries, which captures aid from the North, comes from the OECD International Development Statistics (IDS) data base. DAC countries are predominant donors, providing 70 percent of ODA funding in the 2005–2013 period.

Since the model explains aid-for-trade that does not hinge on conditioning,[17] the existence of this aid component is identified from related applied tariff and aid adjustments. This empirical strategy can be interpreted as tracing small parameter movements reinstating equilibrium after minor conditioning changes (e.g., with respect to availability of overall aid funding) that lack theoretical relevance but is required for identification. Period-to-period parameter changes are analysed to examine the aid-for-trade mechanism.

The donor aid preference is at the core of our model, affecting the upper and lower bound of the tariff overhang. The upper (tariff) bound depends on the donor incentive to give aid at the time of negotiations while the lower bound (i.e., applied tariff rate) depends on donor motivations at the time of the agreement. While any ODA eligible country constitutes the South at negotiation stage, donors have an evident aid preference for those that receive ODA. An aid recipient indicator capturing if the country receives ODA donations from DAC countries in the negotiation period is therefore included in the bound tariff estimations. With aid recipients placed in focus, a direct measure of the donor motivation to aid a country is the state preference captured by the voting similarity between the country and DAC donors in the UN general assembly. DAC donors give more aid to countries with a higher voting similarity on UN general assembly resolutions (see, e.g., Alesina and Dollar, 2000). State preferences are commonly captured by voting similarity in this assembly, and its measurement should incorporate detailed voting information and be disentangled from repetitive agenda setting to avoid bias (Voeten, 2013). Our donor aid preference measure is therefore based on ideal point estimates incorporating these features (Bailey et al., 2017). The voting similarity is calculated as the arithmetic or donor-weighted donor-recipient similarity average using dyadic UN general assembly voting data provided on Erik Voeten's Harvard Dataverse homepage and (overall) donor ODA commitment share weights. The donor aid preference parameter is denoted by a subscript to indicate alternative arithmetic mean (subscript 1) and donor-recipient weighted (subscript 2) measurement.

4.3. Other determinants

Other model parameters are measured as follows. The political influence of import-competing interests is indirectly measured by a political organization indicator I_{po} (i.e., $\theta > 1$ if $I_{po} = 1$). Following Ludema and Mayda (2013), we construct this indicator from trade association listings in the World Guide to Trade Associations (Zils, 1999) and industry import data from the UNCTAD COMTRADE data base.[18] Trade association listings are reported for the year 1998, which can be argued to give a reasonable approximation of the organizational behaviour of import-competing interests over the investigated time period as the political organization of these interests is highly persistent over time due to a combination of high organizational costs and large net gains from influencing policy (Olson, 1965). The market size is measured by the GDP level (Broda et al., 2008) in natural logarithms of US Dollars with data from the World Bank WDI data base. The North's relative export supply is measured by the total export share of DAC countries to the country calculated from COMTRADE export data. The export value excludes the transport cost, insurance and freight.

In addition, economic development and new member controls are used to account for development-related factors outside the model and stricter post-round negotiation terms. A country's economic development level is measured by GDP per capita in natural logarithms of US Dollars based on GDP and population WDI data. The new member indicator, which captures negotiation of agreement terms after the Uruguay round was finalised in 1994, is constructed from WTO web site information.

4.4. Instruments

Instrumental variable (IV) methods are used to estimate causal parameter effects. While bound tariff determinants are generally exogenous (as there are no feedback effects of subsequently implemented tariff outcomes), aid recipients may negotiate higher tariff ceilings because donors regard additional leverage as an alternative form of aid. To remedy this potential issue, the aid recipient effect is instrumented by the underlying donor state preference and the development control is instrumented by a financial market access index from the International Monetary Fund (IMF) Financial Development Index data base.[19] The financial market access of individuals and companies (i.e., the market presence of financial intermediaries) has been shown to function as a central stimulating factor for economic development (Levine, 2005).

Applied tariffs are simultaneously determined with the donor aid preference, aid and importer market power while tariff bounds and politically influential import-competing interests are predetermined. The aid adjustment is instrumented by the proportional change in DAC ODA commitments between (replenishment) periods. The donor

[15] National tariff implementation is defined by so-called tariff lines, which implies that the tariff reporting can mask underlying import alterations at tariff lines below product level. This has a negligible impact on tariff measurement as assessed from bound tariff rates set by the agreement.

[16] To provide consistent measurement, we exclude aid given as ODA for transition purposes after a 2005 classification reform.

[17] The model's aid-for-trade mechanism is not equivalent to aid used under the epithet to facilitate recipient trade (to build transport infrastructure, improve customs handling procedures etc.).

[18] The matching, which relies on subjective judgement (as the listings are not reported by any standard classification), is available upon request.

[19] See Svirydzenka (2016) for a detailed index description.

aid preference instrument is a (liberal) democracy indicator for the negotiation period based on evidence that this was a central divisive factor of (donor) state preferences from the 1990s onwards (Voeten, 2013). The indicator is constructed from the Executive Index of Electoral Competition provided in the World Bank Database of Political Institutions.[20] To instrument market size, the arable land area and the mean annual temperature are used as production opportunities in developing countries often hinge on agricultural conditions. The arable land area is measured in natural logarithms of squared kilometres using WDI data and the temperature is measured in degrees Celsius with data from the World Bank Climate Change Knowledge Portal data base. The distance is measured in natural logarithms of kilometres using data based on the great circle formula of distances between main cities/agglomerations (including internal distances) from the CEPII GeoDist data base.[21] As previously described, financial market access is used as economic development instrument.

4.5. Sample descriptives

The bound tariff regression sample includes countries that are ODA eligible negotiating their Uruguay agreement terms. ODA country eligibility, which is determined under the auspice of IDA, is reported by replenishment period on the association's web site. The bound tariff regression sample contains a predominant majority of countries that were ODA eligible at the time of their tariff negotiations (84 percent). It is mainly restricted by data availability problems for new members,[22] which leads to an over-representation of poor developing countries that receive a lot of aid and set high tariff bounds. This may bias the γ-parameter effect upwards. The applied tariff regression sample includes a large share of aid recipients that are WTO members when the Uruguay agreement is in force (87 percent). Countries excluded from the sample are heterogeneous with no apparent effect on representativeness.[23] Country listings for the bound and applied tariff regression samples are provided in Table B.1 and Table B.2. Parameters are highly correlated between samples (ρ_{γ_1}=0.995, ρ_{γ_2}=0.995, ρ_n=0.972 and ρ_δ=0.715),[24] implying that their tariff effects hinge on level relationships as set out in our model. Limited period-to-period adjustments needed to examine the aid-for-trade mechanism reduce the country sample to 85 out of 106 countries in the aid recipient WTO category. These consist of the predicted change in the applied tariff rate $\Delta\hat{\tau}^a$ and the aid alteration Δa. Countries dropped from the applied tariff regression sample in this exercise are mostly small island developing states that are relatively unimportant aid recipients. Sample summary statistics of parameters and instruments are reported in Table B.3 and Table B.4.

5. Empirics

We bring our theory to data investigating model predictions for tariff bound outcomes of the negotiations and applied tariff determination once the agreement is in force. The parameter relationships set out in theory are primarily tested from cross-country data variation (in cross-section and panel regressions). The exercise of examining related parameter adjustments (for aid-for-trade identification purposes) rely on this main explanatory power as conveyed in predicted applied tariff alterations.

5.1. Bound tariff formation

The bound tariff outcome of the negotiations (stage 1) is examined using the following empirical specification:

$$\tau_i^b = \alpha_p + \beta_1 I_{a,ip} + \beta_2\theta(I_{po,i}) + \beta_3 n_{ip} + \beta_4\delta_{ip} + \mu_{ip}\ , \tag{24}$$

where i and p denotes the country and (negotiation) period, α_p is a period effect,[25] $I_{a,ip}$ is an indicator capturing if the country is an aid recipient in the period, θ is the political influence of import-competing interests on the country's government (measured via the political organization indicator $I_{po,i}$), n_{ip} is the country's market size in the period, δ_{ip} is the donor export supply vis-à-vis the country in the period and μ_{ip} is an error term. Eq. (24) is estimated using two-stage-least-squares (2SLS) with WTO entry clustered standard errors.[26] It is re-estimated in extended form including controls for economic development λ_i and new membership ξ_i.

Bound tariff regression results are presented in Table 2. Empirical model performances are fine and the estimated parameter coefficients support our model predictions. Governments to whom donors are more interested to give aid negotiate higher tariff bounds. The smallest $I_{a,ip}$ parameter estimate is 0.54, implying that aid recipients have tariff bounds that are at least 54 percentage points higher than other South countries. The large effect, which is quantified with donor aid preference instruments, persists controlling for development-related factors outside the model (including altruistic donor behaviour). While the impact may be upward biased, the results confirm that tariff negotiation outcomes are influenced by donor incentives consistent with our model. Governments facing political pressure use higher tariff ceilings. The estimated θ-effect is roughly 0.11, which implies that the bound tariff rate is 11 percentage points higher in countries with politically organized import-competing interests. Governments with larger importer market power set lower tariff bounds. The n-effect is estimated at −0.03 in regressions including development controls, which translates into a 6.7 percentage point lower bound tariff rate in Tanzania, a country of intermediate size, compared to Djibouti, a small market in our sample. The corresponding estimated δ-effect is around −0.31 implying that the supply degree of donor exports contributes to a 8.7 percentage point lower bound tariff rate in Mexico compared to Pakistan. The results show that development-related factors outside the model matters but give no indication of more restrictive post-round negotiation conditions with model parameters taken into account.

5.2. Applied tariff formation

Applied tariff setting under the Uruguay agreement (at stage 2) is described by the following empirical specification:

$$\tau_{ip}^a = \alpha_p + \beta_1\tau_i^b + \beta_2\gamma_{ip} + \beta_3\theta(I_{po,i}) + \beta_4 n_{ip} + \beta_5\delta_{ip} + \mu_{ip}, \tag{25}$$

where i and p denote the country and period, α_p is a period effect, τ_i^b is the tariff bound, γ_{ip} is the donor aid preference for the country in the period, θ is the political influence of import-competing interests (captured by their political organization $I_{po,i}$), n_{ip} is the country's market size in the period, δ_{ip} is the North's export supply vis-à-vis the country in the period, and μ_{ip} is an error term. Eq. (25) is estimated for weakly bound MFN tariff rates using 2SLS with WTO entry clustered standard errors.

The applied tariff regression results are presented in Table 3. Results are largely consistent across estimations and key model predictions receive support. Most notably, governments with higher tariff

[20] As per the set standard, an index value above 6 is categorized as a democratic system.

[21] See Mayer and Zignago (2011) for details.

[22] Bahrain, Botswana, Hong Kong, Kuwait, Kyrgyz Republic, Laos, Lesotho, Macao, Montenegro, Myanmar, Namibia, Oman, Qatar, Russia, Samoa, Saudi Arabia, Swaziland, Tajikistan and Vanuatu are excluded due to data limitations.

[23] Countries excluded due to data constraints are Antigua and Barbuda, China, Dominica, Kyrgyz Republic, Laos, Macedonia, Montenegro, Oman, Samoa, St. Kitts and Nevis, St Vincent and the Grenadines, Tajikistan, Tonga and Vanuvatu.

[24] As previously described, our θ measure is time invariant.

[25] The Uruguay round negotiation period is used as baseline of subsequent 3-year interval periods in the regression. Post-round negotiations that partially overlap these periods are measured directly (as fractions).

[26] GATT Uruguay round participants entered the WTO when it was initiated as part of the round's completion in 1995.

Table 2
Bound tariff regression results.

I_a	0.624***,[a]	0.619***,[b]	0.547***,[a]	0.540***,[b]	0.596***,[a]	0.587***,[b]
	(0.167)	(0.168)	(0.135)	(0.134)	(0.157)	(0.155)
$\theta(I_{po})$	0.114***	0.115***	0.119***	0.120***	0.113***	0.114***
	(0.033)	(0.033)	(0.031)	(0.032)	(0.030)	(0.030)
n	−0.029***	−0.029***	−0.025***	−0.025***	−0.025***	−0.025***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
δ	−0.317***	−0.318***	−0.315***	−0.316***	−0.313***	−0.314***
	(0.039)	(0.039)	(0.039)	(0.038)	(0.041)	(0.040)
λ			−0.027***	−0.027***	−0.024***	−0.024***
			(0.007)	(0.007)	(0.009)	(0.009)
ξ					0.182	0.175
					(0.125)	(0.126)
R-squared	0.139	0.142	0.200	0.204	0.171	0.176
Exogeneity test (p-value)	0.000	0.000	0.000	0.000	0.000	0.000
Nobs	103	103	100	100	100	100

Notes: Reporting 2SLS regressions including alternative donor state preference I_a-instruments, a financial market access λ-instrument and period effects. WTO entry clustered standard errors in parenthesis. *** $p < 0.01$.
[a] γ_1 at $I_a = 1$.
[b] γ_2 at $I_a = 1$.

bounds levy higher (applied) tariffs and governments that donors have a stronger preference to give aid set lower tariffs. The estimated τ^b-effect is at least 0.04 corresponding to a 4.5 percentage point induced difference between the MFN tariff rate of Djibouti, which has a medium-sized tariff bound, and Bangladesh, which has the highest tariff ceiling in the sample. The γ-parameter estimate is at least −0.13 or −0.16 (depending on measurement) corresponding to a roughly 5.2–5.3 percentage point lower MFN tariff rate in Belize, a country that donors have medium incentives to aid, compared to Cuba, the country that donors have the least interest in aiding. This impact captures donor aid incentives consistent with theory (i.e., using development controls of altruistic donor incentives). The estimated θ-effect is insignificant controlling for economic development, indicating that its effect is channelled via the tariff bound.[27] Governments with stronger importer market power set higher tariffs based on a larger supply degree of exports from the North but not with respect to the importer market size. This may reflect that the δ-effect is the dominating influence of importer market power if the market size relates negatively to the domestic production capacity of import-competing producers. We do not access data to explore this issue further but note that it could be useful to disentangle importer market power fundaments to underpin tariff implementation. The results show that development-related factors outside the model affect tariff protection.

5.3. Aid-for-trade

The aid-for-trade mechanism is examined regressing Δa on $\Delta\hat{\tau}^a$ predicted from the estimated Eq. (24) and its extended version. In effect, this constitutes the first-difference estimator incorporating known (i.e., estimated) parameter coefficients and observed data variation. The results of this exercise are presented by specification in Table 4. The existence of an aid-for-trade effect is confirmed and equal to −0.03, which corresponds to a tariff response ranging from a 6 percentage point lower rate in Botswana to a 15.1 percentage point higher rate in Croatia.

[27] It can be noted that the measurement of this parameter via the preset organization of import-competing interests is limiting compared to finer measures of political influence on disaggregated (i.e., industry level) tariff formation outside the scope of this paper.

Table 3
Applied tariff regression results.

τ^b	0.057***	0.055***	0.043**	0.043**
	(0.016)	(0.016)	(0.017)	(0.017)
γ	−0.170***,[a]	−0.219***,[b]	−0.129***,[a]	−0.164***,[b]
	(0.030)	(0.029)	(0.031)	(0.038)
θ	−0.019***	−0.025***	−0.007	−0.008
	(0.007)	(0.006)	(0.008)	(0.008)
n	−0.003*	−0.002	−0.005***	−0.005***
	(0.001)	(0.001)	(0.001)	(0.001)
δ	0.152**	0.162**	0.170***	0.169***
	(0.076)	(0.079)	(0.062)	(0.062)
λ			−0.010***	−0.010***
			(0.002)	(0.002)
R-squared	0.220	0.206	0.253	0.254
Exogeneity test (p-value)	0.000	0.000	0.000	0.001
No of countries	92	94	89	89
Nobs	235	242	228	228

Notes: Reporting 2SLS regressions including a democracy indicator γ-instrument, arable land area and mean temperature n-instruments, a financial market access λ-instrument and period effects. WTO entry clustered standard errors in parenthesis. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
[a] γ_1.
[b] γ_2.

Table 4
Aid-for-trade results.

	$\Delta\hat{\tau}^a$	$\Delta\hat{\tau}^a$	$\Delta\hat{\tau}^a$	$\Delta\hat{\tau}^a$
Δa	−0.033***	−0.033***	−0.034**	−0.034**
	(0.013)	(0.013)	(0.013)	(0.013)
Exogeneity test (p-value)	0.000	0.000	0.000	0.000
No of countries	85	85	83	83
Nobs	144	144	140	140

Notes: Reporting 2SLS regressions of Δa on $\Delta\hat{\tau}^a$ by column specification in Table 3 using the (period-to-period) replenishment alteration as aid instrument. Robust standard errors reported.** $p < 0.05$, *** $p < 0.01$.

6. Conclusions

In this paper, we identified and analysed development aid as a possible explanation for tariff overhangs, i.e., for gaps between negotiated tariff ceilings and actual tariff rates. Tariff overhangs can be seen as collateral to induce aid payments from developed to developing countries. In a simple theoretical model that combines aid for tariff concessions with negotiations on tariff ceilings, we derived clear predictions on the relationship between donor aid interests and tariff overhangs. With an increase in aid payments, the North can buy down the applied tariff rate levied on its exports. In anticipation of this effect, the bound tariff is set higher in negotiations with a lower (political) cost of giving aid. In our empirical analysis, we examined tariffs under the Uruguay agreement to test the tariff predictions using a data set including a predominant majority of the aid recipients that participated in the Uruguay round. Our empirical results support the main model predictions and give direct evidence consistent with the aid-for-trade mechanism.

We provide a supplementary explanation for the use of tariff overhangs that can be particularly important to understand tariff determination in poor countries. While we have empirically analysed tariffs under the Uruguay agreement, the perspective of aid as a market opening tool can be of increasing importance with the more recent emphasis on developing countries in the WTO.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

STATA data sets and replication files are included as online content.

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Appendix A. Analytical derivations

Comparative Statics. The influence of τ^b and γ on the applied tariff τ^a and the aid level a can be derived from (1) and (3):

$$\frac{d\tau^a}{d\tau^b} = -\frac{C_{aa}(a)\cdot V_\tau^S(\tau^b)\cdot V_\tau^S(\tau^a)}{SOC} > 0\,,$$
$$\frac{da}{d\tau^b} = \frac{V_\tau^S(\tau^b)\cdot\left[V_{\tau\tau}^N(\tau^a)+C_a(a)\cdot V_{\tau\tau}^S(\tau^a)\right]}{SOC} > 0\,,$$
$$\frac{d\tau^a}{d\gamma} = -\frac{C_{a\gamma}(a)\cdot V_\tau^S(\tau^a)}{SOC} < 0 \quad\text{and}\quad \frac{da}{d\gamma} = \frac{C_{a\gamma}(a)\cdot\left(V_\tau^S(\tau^a)\right)^2}{SOC} > 0\,, \tag{A.1}$$

with $SOC = V_{\tau\tau}^N(\tau^a) + C_a(a)\cdot V_{\tau\tau}^S(\tau^a) - C_{aa}(a)\cdot\left(V_\tau^S(\tau^a)\right)^2 < 0$. The tariff overhang $\tau^b-\tau^a$ increases in the bound rate since $1 - d\tau^a/d\tau^b > 0$ or

$$\frac{V_{\tau\tau}^N(\tau^a)+C_a(a)\cdot V_{\tau\tau}^S(\tau^a)-C_{aa}(a)\cdot V_\tau^S(\tau^a)\cdot\left[V_\tau^S(\tau^a)-V_\tau^S(\tau^b)\right]}{SOC} > 0\,.$$

For the influence of θ, δ and n, we totally differentiate Eqs. (18) and (19) to obtain

$$da = -\frac{n\cdot(1+2n)\cdot(\tau^o-\tau^a)}{(1+n)^2}d\tau^a + \frac{n\cdot(\tau^b-\tau^a)}{1+n}d\theta + \frac{n^2\cdot(\tau^b-\tau^a)}{(1+n)^2}\cdot d\delta + \left[\frac{n\cdot(\delta-\tau^*)}{1+2n}+\frac{(2\tau^o-\tau^b-\tau^a)\cdot(1+3n)}{2(1+n)}\right]\cdot\frac{\tau^b-\tau^a}{(1+n)^2}\cdot dn \tag{A.2}$$

and

$$d\tau^a = \frac{(\delta-\tau^*)\cdot x_a}{(1+x)^2}\cdot da + \frac{1}{1+x}\cdot d\theta + \frac{x}{1+x}\cdot d\delta + \frac{(\delta-\tau^*)\cdot x_n}{\cdot(1+x)^2}\cdot dn\,. \tag{A.3}$$

For $a=\gamma$, we have $x=0$, $\tau^a=\tau^*$, $x_n=0$ and $x_a = n/(1+n)$ yielding

$$da = -\frac{n^2\cdot(\delta-\tau^*)}{(1+n)^2}d\tau^a + \frac{n\cdot(\tau^b-\tau^*)}{1+n}d\theta + \frac{n^2\cdot(\tau^b-\tau^*)}{(1+n)^2}\cdot d\delta + \left[\frac{n\cdot(\delta-\tau^*)}{1+2n}+\frac{(2\tau^o-\tau^b-\tau^*)\cdot(1+3n)}{2(1+n)}\right]\cdot\frac{\tau^b-\tau^*}{(1+n)^2}\cdot dn \tag{A.4}$$

and

$$d\tau^a = \frac{n}{1+n}\cdot(\delta-\tau^*)\cdot da + d\theta\,. \tag{A.5}$$

The influence of θ on τ^a and a can be determined from (A.4) and (A.5) as

$$\frac{d\tau^a}{d\theta} = \frac{(1+n)^3+(1+n)\cdot n^2\cdot(\delta-\tau^*)\cdot(\tau^b-\tau^*)}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2} > 0 \quad\text{and}$$
$$\frac{da}{d\theta} = \frac{n\cdot(1+n)\cdot\left[(1+n)\cdot(\tau^b-\tau^*)-n(\delta-\tau^*)\right]}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2}\,. \tag{A.6}$$

The term in squared brackets in (A.6) is negative if

$$\tau^b < \tau^* + \frac{n\cdot(\delta-\tau^*)}{1+n}\,. \tag{A.7}$$

With $\tau^b < \tau^o$, this inequality is satisfied such that $da/d\theta < 0$.

For the influence of θ on τ^b condition (20) yields

$$\frac{d\tau^b}{d\theta} = -\frac{(1+n)\cdot(\tau^b-\tau^*)-n\cdot(\delta-\tau^*)}{(1+2n)\cdot(\tau^o-\tau^b)}\,, \tag{A.8}$$

which is positive because of (A.7). Setting $d\theta=0$ and $dn=0$ Eqs. (A.2) and (A.5) determine

$$\frac{d\tau^a}{d\delta} = \frac{n^3\cdot(\delta-\tau^*)\cdot(\tau^b-\tau^*)}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2} > 0 \quad\text{and}$$
$$\frac{da}{d\delta} = \frac{n^2\cdot(1+n)\cdot(\tau^b-\tau^*)}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2} > 0\,, \tag{A.9}$$

while the bound rate declines in δ as the following derivative of (20) shows:

$$\frac{d\tau^b}{d\delta} = -\frac{n\cdot(\tau^b-\tau^*)}{(1+2n)\cdot(\tau^o-\tau^b)} < 0\,. \tag{A.10}$$

For the effects of an increase in n, we finally obtain

$$\frac{d\tau^a}{dn} = \frac{n\cdot(\tau^b-\tau^*)\cdot(\delta-\tau^*)\cdot\left[\frac{n\cdot(\delta-\tau^*)}{1+2n}+\frac{(2\tau^o-\tau^b-\tau^*)\cdot(1+3n)}{2(1+n)}\right]}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2} > 0 \quad\text{and}$$
$$\frac{da}{dn} = \frac{(1+n)\cdot(\tau^b-\tau^*)\cdot\left[\frac{n\cdot(\delta-\tau^*)}{1+2n}+\frac{(2\tau^o-\tau^b-\tau^*)\cdot(1+3n)}{2(1+n)}\right]}{(1+n)^3+n^3\cdot(\delta-\tau^*)^2} > 0\,. \tag{A.11}$$

Taking the derivative of (20) with respect to n yields

$$\frac{d\tau^b}{dn} = -\frac{n^2(\delta-\tau^*)\cdot(\tau^b-\tau^*)+(1+n)\cdot(1+3n)\cdot\gamma}{n^2\cdot(1+2n)^2\cdot(\tau^o-\tau^b)} < 0\,. \tag{A.12}$$

Parametric requirements. To determine the parametric requirements for a solution of (20), we note that the left hand side of (20) has its maximum at $\tau^b=\tau^o$. An interior solution for τ^b, therefore, can only exist if

$$(\tau^o-\tau^*)^2 > \frac{2\gamma\cdot(1+n)^2}{n\cdot(1+2n)} \quad\text{or}$$
$$\gamma < \frac{n^3\cdot(\delta-\tau^*)^2}{2\cdot(1+2n)\cdot(1+n)^2}\,. \tag{A.13}$$

Appendix B. Sample descriptives

Table B.1
Bound tariff regression country sample.

Albania	Guyana	Suriname
Angola	Haiti	Tanzania
Antigua & Barbuda	Honduras	Thailand
Argentina	India	Togo
Armenia	Indonesia	Tonga
Bangladesh	Israel	Trinidad & Tobago
Barbados	Jamaica	Tunisia
Belize	Jordan	Turkey
Benin	Kenya	Uganda
Bolivia	Korea, Republic	United Arab Emirates
Brazil	Macedonia	Uruguay
Brunei Darussalam	Madagascar	Venezuela
Bulgaria	Malawi	Vietnam
Burkina Faso	Malaysia	Zambia
Burundi	Maldives	Zimbabwe
Cambodia	Mali	
Cameroon	Mauritania	
Cape Verde	Mauritius	
Central African Republic	Mexico	
Chad	Moldova	
Chile	Mongolia	
China	Morocco	
Colombia	Mozambique	
Congo, Democratic Republic	Nepal	
Congo, Republic	Nicaragua	
Costa Rica	Niger	
Côte D'Ivoire	Nigeria	
Croatia	Pakistan	
Cuba	Panama	
Djibouti	Papa New Guinea	
Dominica	Paraguay	
Dominican Republic	Peru	
Ecuador	Philippines	
Egypt, Arab Republic	Romania	
El Salvador	Rwanda	
Fiji	Senegal	
Gabon	Sierra Leone	
Gambia	Singapore	
Georgia	Solomon Islands	
Ghana	South Africa	
Grenada	Sri Lanka	
Guatemala	St. Kitts & Nevis	
Guinea	St. Lucia	
Guinea-Bissau	St. Vincent & the Grenadines	

Table B.2
Applied tariff regression country sample.

Albania	Indonesia	Uganda
Angola	Jamaica[a]	Uruguay
Argentina	Jordan	Venezuela
Armenia	Kenya	Vietnam
Bangladesh	Lesotho	Zambia
Barbados[a]	Madagascar	Zimbabwe[a]
Belize	Malawi	
Benin	Malaysia	
Bolivia	Maldives	
Botswana	Mali	
Brazil	Mauritania[a]	
Burkina Faso	Mauritius	
Burundi	Mexico	
Cambodia	Moldova	
Cameroon	Mongolia	
Cape Verde	Morocco	
Central African Republic[a]	Mozambique	
Chad	Myanmar	
Chile	Namibia	
Colombia	Nepal	
Congo, Democratic Republic	Nicaragua	
Congo, Republic	Niger	
Costa Rica	Nigeria	
Croatia	Pakistan	

Table B.2 (*continued*).

Cuba	Panama
Djibouti	Papa New Guinea
Dominican Republic	Paraguay
Ecuador	Peru
Egypt, Arab Republic	Philippines
El Salvador	Rwanda
Fiji	Senegal
Gabon	Sierra Leone
Gambia	Solomon Islands[a]
Georgia	South Africa
Ghana	Sri Lanka
Grenada	St. Lucia[a]
Guatemala	Suriname
Guinea	Swaziland
Guinea-Bissau	Tanzania
Guyana	Togo
Haiti	Trinidad & Tobago
Honduras	Tunisia
India	Turkey

[a] Excluded from aid-for-trade exercise.

Table B.3
Parameter summary statistics.

Regression	Parameter	Mean	STD	Min	Max
τ^b	τ^b	0.425	0.287	0.060	1.482
τ^b	I_a	0.951	0.216	0	1
τ^b	I_{po}	0.757	0.431	0	1
τ^b	n	22.59	1.960	19.27	27.74
τ^b	δ	0.677	0.173	0.155	0.951
τ^b	λ	7.013	1.213	4.930	10.16
τ^b	ξ	0.175	0.382	0	1
τ^a	τ^a	0.112	0.047	0.011	0.287
τ^a	τ^b	0.443	0.287	0.060	1.482
τ^a	γ_1	0.483	0.159	0.085	0.920
τ^a	γ_2	0.484	0.126	0.180	0.840
τ^a	I_{po}	0.776	0.418	0	1
τ^a	n	23.65	1.827	20.25	28.55
τ^a	δ	0.422	0.159	0.023	0.858
τ^a	λ	7.603	1.118	5.100	9.768
$\Delta\widehat{\tau^a}$	$\widehat{\tau^a}$	−0.005	0.015	−0.086	0.021
$\Delta\widehat{\tau^a}$	Δa	0.040	0.807	−5.046	2.050

Table B.4
Instrument summary statistics.

Regression	Parameter	Instrument	Mean	STD	Min	Max
τ^b	I_a	γ_1	0.496	0.167	0.078	0.922
τ^b	I_a	γ_2	0.492	0.149	0.132	0.868
τ^b	λ	FMA index	0.094	0.152	0	0.534
τ^a	γ	Democracy indicator	0.759	0.429	0	1
τ^a	n	Arable land	14.16	2.120	7.144	18.88
τ^a	n	Temperature	22.55	5.920	−0.461	29.08
τ^a	δ	Distance to China	9.189	0.515	7.067	9.868
τ^a	λ	FMA index	0.118	0.196	0	0.879
$\Delta\widehat{\tau^a}$	Δa	DAC ODA commit. ch.	0.248	0.209	0.001	0.509

Appendix C. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.jdeveco.2023.103209.

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