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Working Paper

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WIDER Discussion Paper, No. 2003/63

Provided in Cooperation with:

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Suggested Citation: Guha-Khasnobis, Basudeb (2003) : Some welfare implications of who goes first? in WTO negotiations, WIDER Discussion Paper, No. 2003/63, The United Nations University World Institute for Development Economics Research (UNU-WIDER), Helsinki

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Discussion Paper No. 2003/63

Some Welfare Implications of ‘Who Goes First?’ in WTO Negotiations

Basudeb Guha-Khasnobis*

September 2003

Abstract

We envisage a logical framework to explain why some trade negotiations are delayed because parties differ on who should ‘go first’. In our model, there are substantive welfare implications depending on which party sets tariff rates (or subsidies) first in a strategic optimization exercise. When knowledge about cost levels are incomplete or missing, and hence must be guessed with a probability, the chances of conflict regarding who goes first are extremely high in the situation modeled in this paper. As an institution with some power to set the rules of negotiations, the WTO should be able to anticipate such conflicts in upcoming negotiations. It can then set the rule (in this case, dictate who should go first) depending on whose interest it wants to protect. There is a wide range of choices for the WTO in this regard: OECD consumer’s surplus, OECD producers’ loss, net exports of developing countries, firm profits, or even, world welfare as the sum of all these components.

Keywords: WTO, tariffs, subsidies, welfare, negotiation

JEL classification: F10, F42, C72

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This study has been prepared within the UNU/WIDER project on The Impact of the WTO Regime on Developing Countries, which is directed by Professor Basudeb Guha-Khasnobis.

UNU/WIDER gratefully acknowledges the financial contribution to the project by the Ministry for Foreign Affairs of Finland.

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Camera-ready typescript prepared by Janis Vehmaan-Kreula at UNU/WIDER
Printed at UNU/WIDER, Helsinki

The views expressed in this publication are those of the author(s). Publication does not imply endorsement by the Institute or the United Nations University, nor by the programme/project sponsors, of any of the views expressed.

ISSN 1609-5774
ISBN 92-9190-512-7 (printed publication)
ISBN 92-9190-513-5 (internet publication)

Introduction

One of the key principles on which the World Trade Organization (WTO) functions is reciprocity, which implies that in order to receive trade-related preferences,¹ a country must be willing to offer similar benefits to the partner trading country. Essentially, it requires that potential trade partners meet, bilaterally or multilaterally, to discuss and negotiate trade policies and preferences. The main price-based outcomes of such negotiations are applied tariff and subsidy rates. The common misgivings about these outcomes can be broadly summarized by saying that both the developing as well as the developed countries feel that commitments to market access made during the Uruguay Round have not been fulfilled one way or the other. Specifically, discriminatory tariff rates continue to affect exports directly, while domestic support (mainly in the form of subsidies) does so indirectly. In view of the persistent, perhaps deepening, divide between nations on the issue of trade liberalization, it appears that the negotiating process at the WTO may not be functioning at its best. At the same time, there seems to be very limited information available to the outsider on exactly how bilateral negotiations take place (Bond *et al.* 2000), especially, if they are sequential or one-shot processes.

In this paper, we consider a simple example of trade negotiations between a developed (importing) and two developing (exporting) countries. The instruments to be negotiated are the tariff rates (to be imposed, not necessarily at a uniform rate, by the developed country on its imports from the two developing countries) and subsidy rates (offered by the developing countries to their respective domestic producers, the firms). Although the developing countries compete with each other with respect to export market share, they act in unison during the negotiation in the sense of deciding ‘who goes first’ in setting trade instruments. We make two alternative assumptions about how the strategies of the involved parties unfold and compare the welfare implications of the two emerging solutions. The purpose of the analysis is to show that the welfare implications of the two solutions are quite different and depend crucially on actual cost levels of the firms, knowledge about which are likely to be imperfect in the real world. We demonstrate that when the actual negotiators (governments, in this case) know cost levels of the firms only up to a probability distribution, they are most likely to be at cross purposes in deciding who should set trade instruments first. Thus, the analysis of this paper provides one explanation behind the common phenomenon of trade negotiations not taking off the ground at all due to a lack of consensus on who goes first.

We consider a partial equilibrium model (see Brander and Spencer 1985) in which there are two firms, one in each developing country (DC), selling an identical product (Q) in the developed (OECD) country. For simplicity, we assume that the firms do not sell the product in their home markets, and, no firm in the OECD country produces an identical product.² In order to maximize national welfare, the OECD government chooses tariffs

¹ For a detailed analysis of reciprocity, see Bagwell and Staiger (1994).

² Instead, the OECD firm(s) produces a product which is a close substitute. The implications are described later.

on the imports from each developing country separately³ whereas the DC governments choose subsidy rates for their firms. Given the tariff and subsidy rates announced by the governments, the DC firms choose output levels to maximize profits. The sub-game perfect equilibrium of the three stage game comprises the set of optimal tariffs, subsidies, and outputs.

Welfare maximization

The following notations are used:

P: price of the good in the OECD country

q(1), q(2): output levels of the two DC firms

t(1), t(2): tariffs imposed by the OECD on the two DC's respectively

s(1), s(2): subsidies provided to the two firms by their respective (DC) governments

c(1), c(2): unit costs incurred by the two firms, respectively

Let $P=1-Q$, where $Q=q(1)+q(2)$, represent the demand curve for the product.

DC governments 1 and 2 maximize, respectively, their export earnings, net of subsidy. These are, respectively:

$$X(1) = [P-t(1)-s(1)]q(1)$$

and

$$X(2) = [P-t(2)-s(2)]q(2)$$

The DC firms maximize profits. These are, respectively:

$$\Pi(1) = [P-t(1)+s(1)]q(1) - c(1)q(1)$$

and

$$\Pi(2) = [P-t(2)+s(2)]q(2) - c(2)q(2)$$

The OECD government maximizes:

$$L = \frac{1}{2}[q(1)+q(2)]^2 + t(1)q(1) + t(2)q(2) - [s(1)+s(2)]^2$$

The welfare function of the OECD government comprises three conceptually different parts, consumer's surplus, tariff revenues and producer's loss. The first two components are standard. The quadratic component $[s(1)+s(2)]^2$ representing producer's loss can

³ See Shieh and Shi (1996) for a comparison between Most Favoured Nation (MFN) and Preferential Tariff Regime (PTR) as optimal choices of tariff regimes.

arise from a wide range of specific demand and cost functions if the product of the OECD firm(s) is a close but imperfect substitute of Q.

Given that there is considerable ambiguity about ‘who goes first’ in such bilateral/trilateral negotiations at the WTO,⁴ we imagine at least two possible scenarios under which the negotiations between the DC and OECD governments may take place. As we shall demonstrate, they have very different implications for the emerging solutions in both qualitative and quantitative terms. In the first, the OECD government sets tariffs first, knowing that its tariff rates will affect the subsequent choices of subsidy rates by the DC governments, and, the choices of output levels by the DC firms. In the alternative case, the DC governments choose their respective subsidy rates simultaneously. In both the cases, the DC firms act last, in the sense of choosing output levels to maximize profits, given both the tariff as well as the subsidy rates.

The OECD government acts first

The three-stage game is solved by backward induction. In Stage 3, the firms take tariffs and subsidies as given and choose their respective output levels. Their respective first order conditions of profit maximization are:

$$\delta\Pi(1)/\delta q(1)=1-2q(1)-q(2)-[t(1)-s(1)+c(1)]=0$$

$$\delta\Pi(2)/\delta q(2)=1-2q(2)-q(1)-[t(2)-s(2)+c(2)]=0$$

Solving the two equations (first order conditions) simultaneously, one can obtain the output levels as functions of t, s and c. Specifically:

$$q(1)=1/3+1/3[t(2)-2t(1)]-1/3[s(2)-2s(1)]+1/3[c(2)-2c(1)]$$

$$q(2)=1/3+1/3[t(1)-2t(2)]-1/3[s(1)-2s(2)]+1/3[c(1)-2c(2)]$$

The total output produced by the two firms together is:

$$Q=q(1)+q(2)=2/3-1/3[(t(1)+t(2))-(s(1)+s(2))+(c(1)+c(2))]$$

In Stage 2, the two DC Governments take the OECD tariffs as given and choose their respective subsidy levels simultaneously to maximize their respective net exports. The first order conditions of net export maximization are obtained by differentiating X(1) and X(2), with respect to s(1) and s(2), respectively. In the first order conditions, we replace q(1) and q(2) with their optimal levels from the firms’ profit maximization outcomes obtained in Stage 3, and arrive at:

$$4t(1)-2t(2)+2s(2)-16s(1)+10c(1)-2c(2)=2$$

$$4t(2)-2t(1)+2s(1)-16s(2)+10c(2)-2c(1)=2$$

⁴ In fact, some negotiations do not get going at all, because of the failure to decide who will act first.

Solving them simultaneously, we obtain the optimum levels of $s(1)$ and $s(2)$ as functions of $t(1)$, $t(2)$, $c(1)$ and $c(2)$ as follows:

$$s(1)=1/21[5t(1)-2t(2)+13c(1)-c(2)-3]$$

$$s(2)=1/21[5t(2)-2t(1)+13c(2)-c(1)-3]$$

In Stage 1, the OECD (or developed country) government chooses tariff levels to maximize net surplus defined above. The OECD is aware that its choice of tariff rates will affect the subsidy rates of the DC governments, and finally, both tariff and subsidy rates will affect the firms' choices of output levels. The first order conditions are:

$$\delta L/\delta t(1)=(-1/3)[q(1)+q(2)]+q(1)+(-2/3)t(1)+1/3t(2)-2/7[s(1)+s(2)]$$

$$\delta L/\delta t(2)=(-1/3)[q(1)+q(2)]+q(2)+(-2/3)t(2)+1/3t(1)-2/7[s(1)+s(2)]$$

After substituting the optimum levels of $s(1)$ and $s(2)$ in terms of $t(1)$, $t(2)$, $c(1)$ and $c(2)$ obtained from the DC governments' optimization in Stage 2, these first order conditions may be solved to obtain the optimum levels of $t(1)$ and $t(2)$ in terms of the exogenous parameters $c(1)$ and $c(2)$ as follows:

$$t(1)=.34-.46c(1)-.26c(2)$$

$$t(2)=.34-.46c(2)-.26c(1)$$

Substituting $t(1)$ and $t(2)$ back in the expressions for optimum $s(1)$ and $s(2)$, we get:

$$s(1)=.53c(1)-.06c(2)-.09$$

$$s(2)=.53c(2)-.06c(1)-.09$$

Note that national subsidy levels vary directly with the costs faced by domestic producers and inversely with the costs faced by competing foreign producers. Next, by substituting back $t(1)$, $t(2)$, $s(1)$ and $s(2)$ in the expressions for optimum $q(1)$ and $q(2)$, we get:

$$q(1)=.19+.14c(2)-.07c(1)$$

$$q(2)=.19+.14c(1)-.07c(2)$$

Quantity supplied by a firm is inversely related to its own cost and directly to the cost faced by the competitor in the other country. Total supply in the market is the sum of $q(1)$ and $q(2)$, $Q=.38+.07[c(1)+c(2)]$, which is positive for any values of $c(1)$ and $c(2)$.

The corresponding market price, implied by the demand function, is:

$$P=1-Q=.62-.07[c(1)+c(2)]$$

Developing countries act first

In the alternative scenario (Scenario 2), the Developing Countries act first. Once again, we solve the three stage game by backward induction. In Stage 3, as before, firms maximize profits, given tariff and subsidy rates. The analytical solutions are unchanged and not repeated. In Stage 2, the OECD Government takes the subsidy levels chosen by the two developing country governments as given and chooses its tariff levels to maximize its own welfare. Note that the key difference in the maximization exercise is that $s(1)$ and $s(2)$ are now exogenously given to the OECD government and not functions of its tariff levels as in the first scenario.

With this difference, we solve the first-order-conditions to obtain optimum $t(1)$ and $t(2)$ as functions of $s(1)$, $s(2)$, $c(1)$ and $c(2)$. To differentiate them from the optimum $t(1)$ and $t(2)$ obtained earlier (under Scenario 1, where the OECD Government acted first), we use asterisks as superscripts.

$$t(1)^* = 1/4 + 3/8s(1) - 1/8s(2) + 1/8c(2) - 3/8c(1)$$

$$t(2)^* = 1/4 + 3/8s(2) - 1/8s(1) + 1/8c(1) - 3/8c(2)$$

In Stage 3, the developing country governments maximize their own welfare functions (which are the same as before) with the difference that $t(1)$ and $t(2)$ are *not* given, but are functions of $s(1)$ and $s(2)$ (as above). For illustration, one may work through the first order condition of the first developing country as follows:

$$\delta c(1)/\delta s(1) = \delta q(1)/\delta s(1) - 2q(1)\delta q(1)/\delta s(1) - q(1)\delta q(2)/\delta s(1) - q(2)\delta q(1)/\delta s(1) - q(1)\delta t(1)/\delta s(1) - t(1)\delta q(1)/\delta s(1) - q(1) - s(1)\delta q(1)/\delta s(1)$$

Analogously, the first order condition for the second developing country is:

$$\delta c(2)/\delta s(2) = \delta q(2)/\delta s(2) - 2q(2)\delta q(2)/\delta s(2) - q(2)\delta q(1)/\delta s(2) - q(1)\delta q(2)/\delta s(2) - q(2)\delta t(2)/\delta s(2) - t(2)\delta q(2)/\delta s(2) - q(2) - s(2)\delta q(2)/\delta s(2)$$

Solving simultaneously the two first order conditions, after setting them equal to zero, yields:

$$s(1)^* = .61c(1) - .02c(2) - .16$$

$$s(2)^* = .61c(2) - .02c(1) - .16$$

Working backwards, we can now solve for optimal tariff levels as:

$$t(1)^* = .21 + .05c(2) - .15c(1)$$

$$t(2)^* = .21 + .05c(1) - .15c(2)$$

There is a significant change in the solution for optimal tariffs, compared to the earlier case. When the OECD government acted first, its tariff levels varied inversely with the cost levels of *both* the developing countries. In the present case, when developing countries act first in the sense of choosing their optimal subsidy levels, the ensuing tariff rates that the OECD country chooses in the subsequent stage continues to vary inversely (with a much smaller coefficient) with the partner developing country's cost level as

before, but *directly* with that of its rival (the other developing country). On both counts, the tariff levels in this scenario (where developing countries act first) are likely to be higher, partially offsetting the first mover ‘advantage’ the developing countries may have earned by choosing subsidy levels first. Precisely, note that the DC governments choose higher subsidies when they act first, aiming to wrest market share from its rival. The OECD government offsets this initiative somewhat, by letting its tariff against a particular DC vary directly with the cost level of the rival DC. Also, the coefficient of inverse variation of the tariff rates with respect to the respective DC’s own cost levels are much smaller.

The exact quantitative differences in the various rates between the two regimes depend on the values of the parameters of the model [c(1) and c(2)]. We shall return to that issue later.

The optimum quantity levels in Scenario 2 are given as:

$$q(1)^* = .29 + .04c(2) - .15c(1)$$

$$q(2)^* = .29 + .04c(1) - .15c(2)$$

Total output in the market is given by the sum of q(1) and q(2) as:

$$Q^* = q(1)^* + q(2)^* = .58 - .11[c(1) + c(2)] \text{ and } P = .42 + .11[c(1) + c(2)]$$

The two sets of results are presented in the text boxes below.

<u>Scenario 1: OECD goes first</u>
$t(1) = .34 - .46c(1) - .26c(2)$
$t(2) = .34 - .46c(2) - .26c(1)$
$s(1) = .53c(1) - .06c(2) - .09$
$s(2) = .53c(2) - .06c(1) - .09$
$q(1) = .19 + .14c(2) - .07c(1)$
$q(2) = .19 + .14c(1) - .07c(2)$
$Q = .38 + .07[c(1) + c(2)]$
$P = 1 - Q = .62 - .07[c(1) + c(2)]$

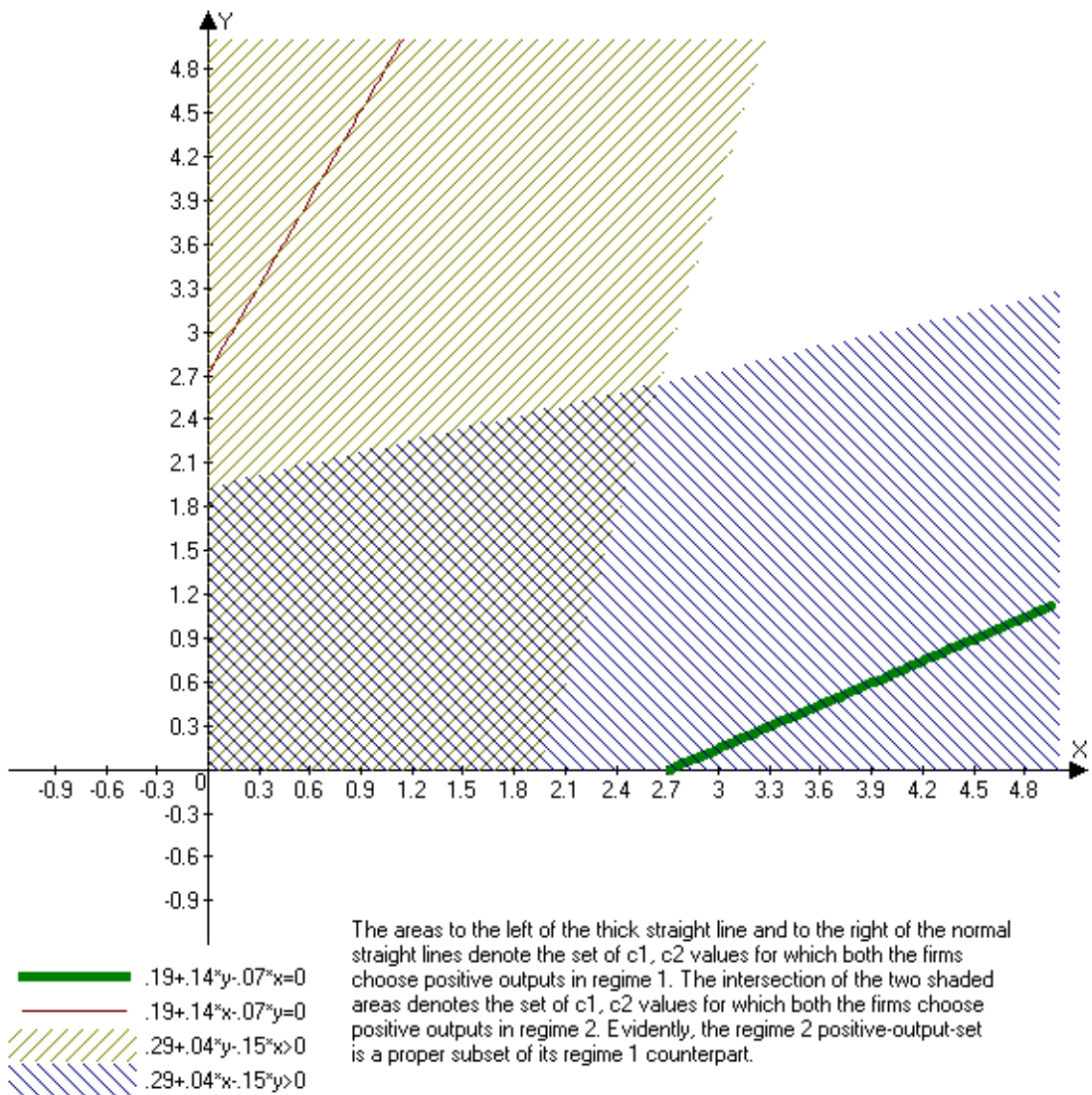
<u>Scenario 2: DC’s go first</u>
$t(1)^* = .21 + .05c(2) - .15c(1)$
$t(2)^* = .21 + .05c(1) - .15c(2)$
$s(1)^* = .61c(1) - .02c(2) - .16$
$s(2)^* = .61c(2) - .02c(1) - .16$
$q(1)^* = .29 + .04c(2) - .15c(1)$
$q(2)^* = .29 + .04c(1) - .15c(2)$
$Q^* = .58 - .11[c(1) + c(2)]$
$P^* = .42 + .11[c(1) + c(2)]$

We note that in Scenario 2, for sufficiently high levels of c(1) and c(2), the market for this commodity may not exist at all. The logic is as follows. Given the opportunity to act first, developing countries choose subsidy rates which vary directly, and more strongly compared to the case where the OECD acts first by setting tariffs, with their own cost levels. The OECD retaliates by trying to reduce this first-mover advantage by imposing

a tariff that varies directly with the rival supplier's cost level. When this cost level is sufficiently high, the tariff level may also be prohibitively high. Since there are no domestic markets in this model, such high tariffs wipe out not just trade, but in effect, the entire existence of this market. In the subsequent analysis, we restrict our attention to the range of $c(1)$ and $c(2)$ values for which both the firms choose positive outputs in both the scenarios.

To understand the main qualitative implications of Scenario 1 relative to Scenario 2, we use a series of graphs depicting the different solutions as well as their differences between scenarios. In all of the graphs to follow, $c(1)$ is measured along the horizontal (x) axis, whereas $c(2)$ is measured along the vertical (y) axis. Accordingly, in the functions representing the different graphs, the variables x and y stand for $c(1)$ and $c(2)$, respectively.

Figure 1
Feasible set of cost levels



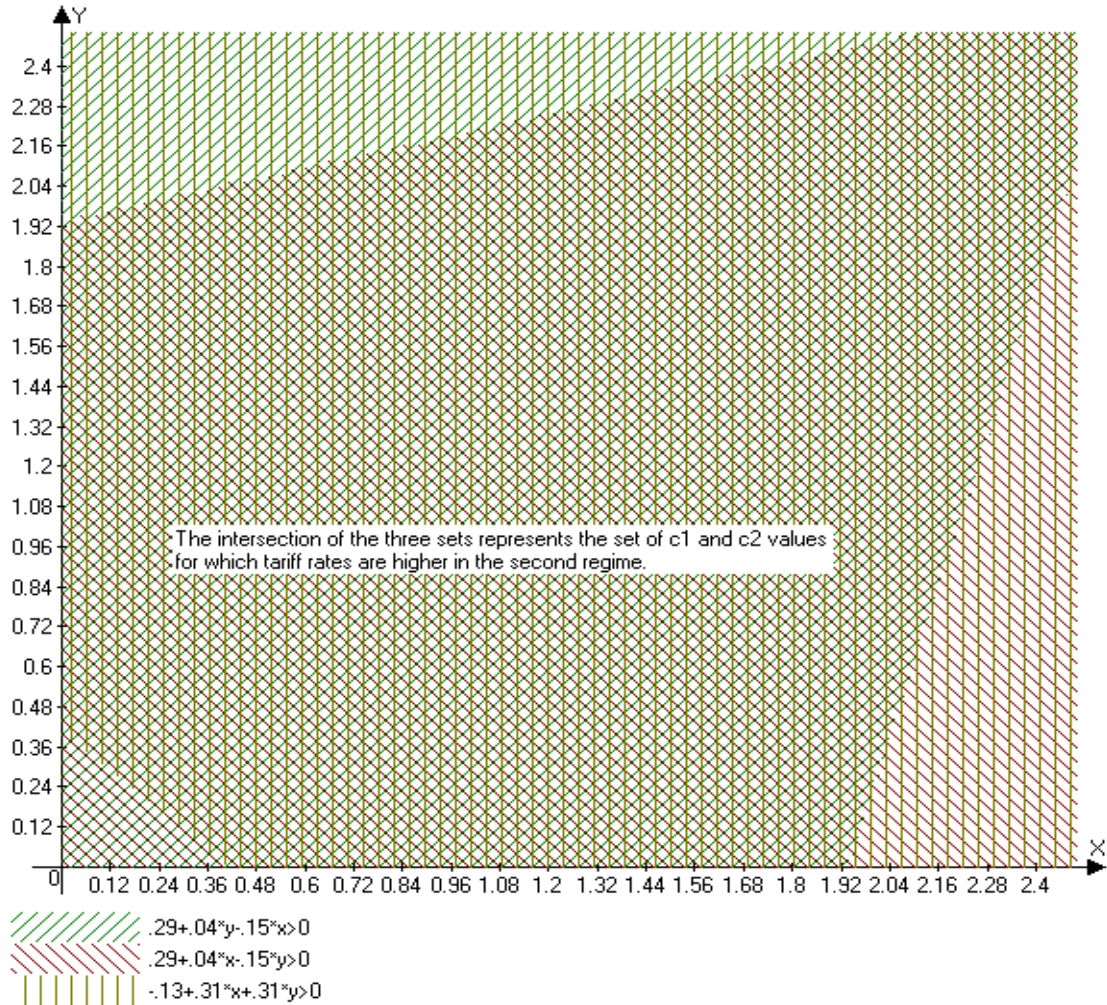
Source: Author.

It is clear from Figure 1 that as long as $c(1)$ and $c(2)$ are each less than or equal to 2, total output under the second regime is positive. Henceforth, we shall narrow the domain of $(c(1),c(2))$ to the closed interval $(2,2)$.

We now compare the tariff and subsidy levels under the two regimes. In each of the graphs to follow, we have plotted the set of $c(1), c(2)$ for which outputs of both the firms are positive in regime 2, and the relevant comparative variable (that is, tariff or subsidy differentials). In calculating ‘differences’, we subtract the Scenario 1 outcome from Scenario 2.

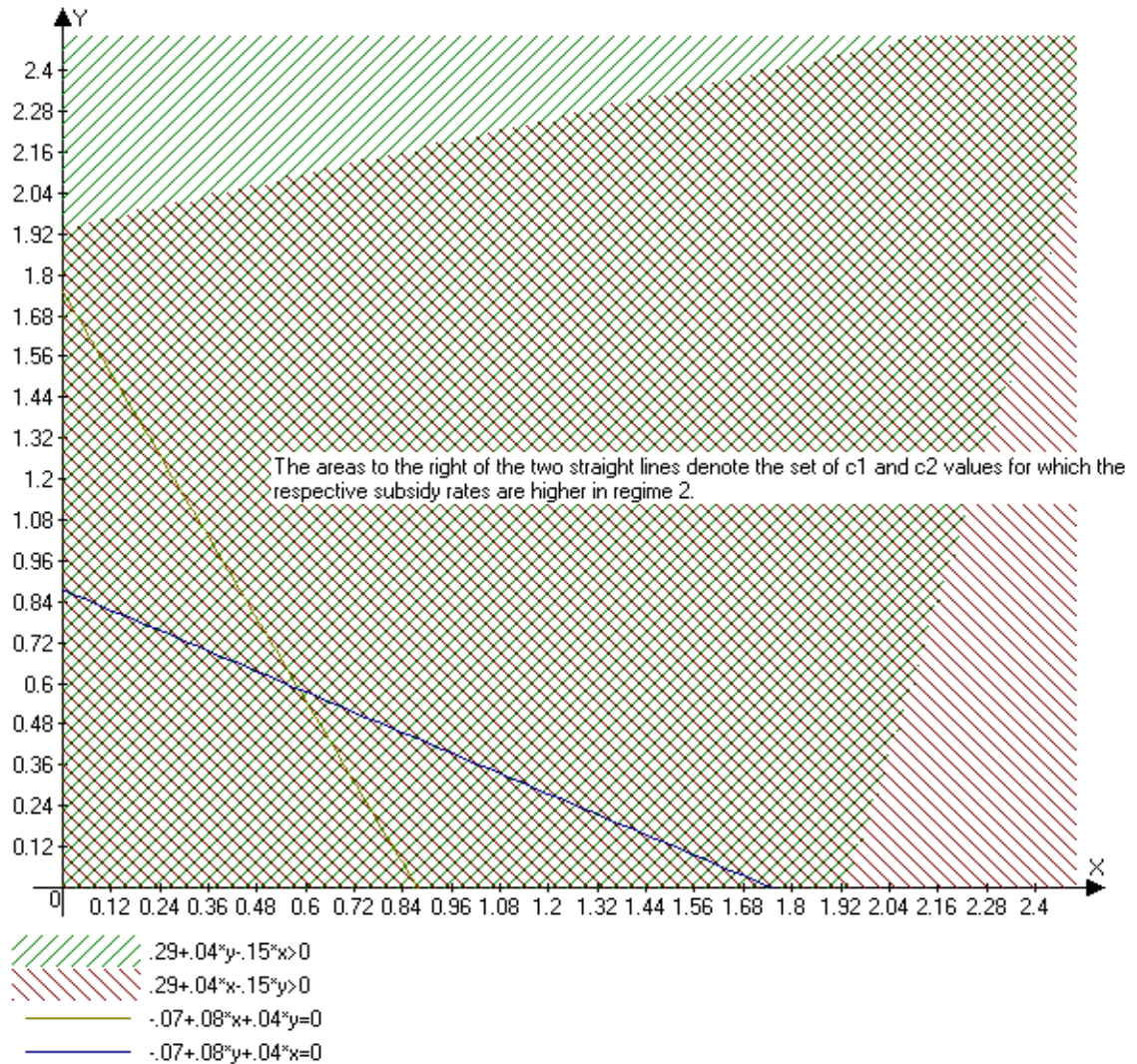
In Figure 2, the intersection of the three sets depict the set of $c(1), c(2)$ values, within the closed set $(2,2)$, for which tariff rates chosen by the OECD government are higher if the DC governments choose subsidies first. The size of this set relative to $(2,2)$ can be interpreted as follows. Usually, exact knowledge about firms’ cost levels is not available to policymakers. However, in the present case, the odds (or probability) favour costs lying in the range which supports higher tariffs in Scenario 2. Therefore, the institution (such as the WTO) which may be involved in setting the rules or modalities of negotiations, will be aware that if the DC governments ‘go first’, prevailing cost levels are more likely to result in subsequent tariff rate choices by the OECD which are *higher* than what they would have chosen if they were asked to go first instead.

Figure 2
Tariff rate comparison



Source: Author.

Figure 3
Subsidy rates comparison



Source: Author.

The implications are similar for subsidy rates too (Figure 3). Thus, trade distorting taxes are generally more likely to be higher if the developing country governments are required to act first during bilateral negotiations of the type assumed in this model.

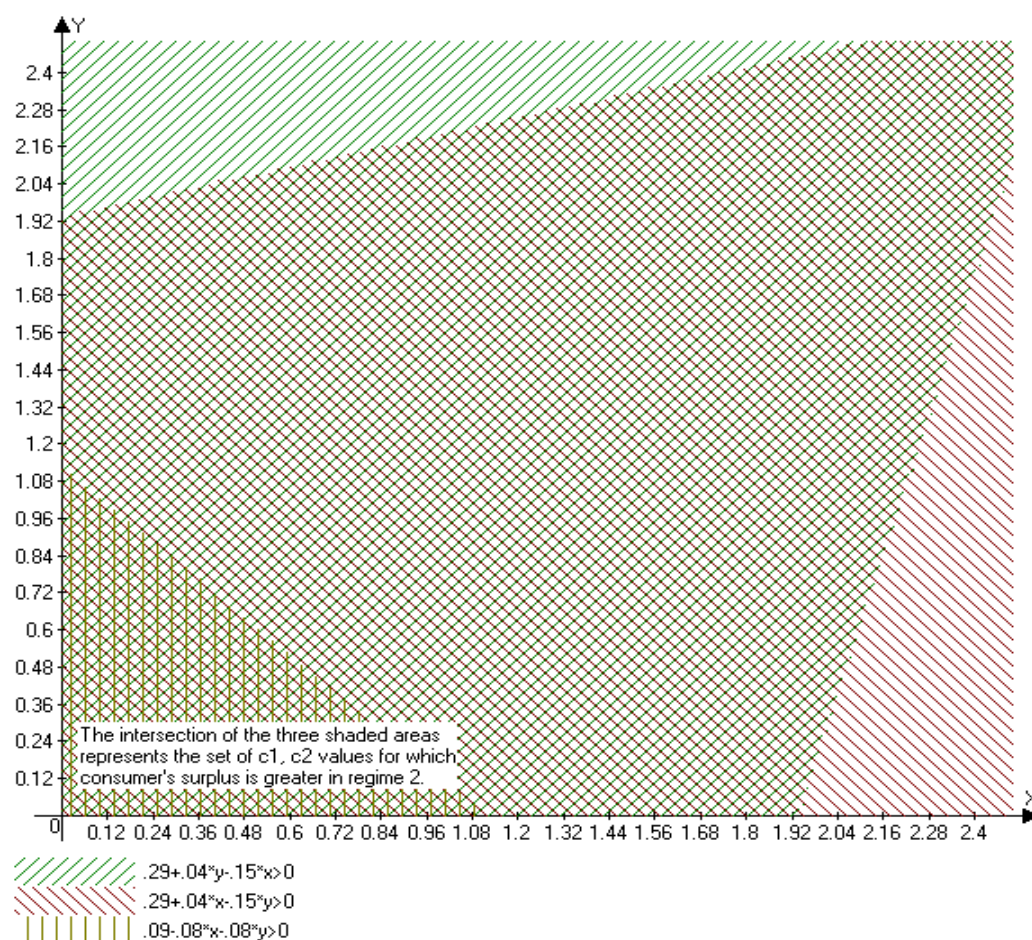
Welfare effects

In this section, we compare the welfare effects of the two negotiating scenarios. As in the previous section, we subtract the value of the relevant variable under the scenario where the OECD acts first from that under the scenario where the developing countries act first.

OECD welfare has three components. The first is 'consumer's surplus (CS)', the change in which, in the present model is given by:

$$\Delta CS = 1/2Q^* - 1/2Q(2) = .09 - .08c(1) - .08c(2)$$

Figure 4
Consumer's surplus in OECD



Source: Author.

From Figure 4, it is clear that the likelihood (implied by actual cost structures) of consumers in the OECD being better off is small if the DC governments act first. The second component in OECD welfare is 'tariff revenue (TR)'. The change in tariff revenue between the two scenarios of negotiation is given by:

$$\begin{aligned}\Delta TR &= (t(1)^* q(1)^* + t(2)^* q(2)^*) - (t(1)q(1) + t(2)q(2)) \\ &= .04c(1) + .04c(2) + .02c(1)^2 + .02c(2)^2 + .10c(1)c(2)\end{aligned}$$

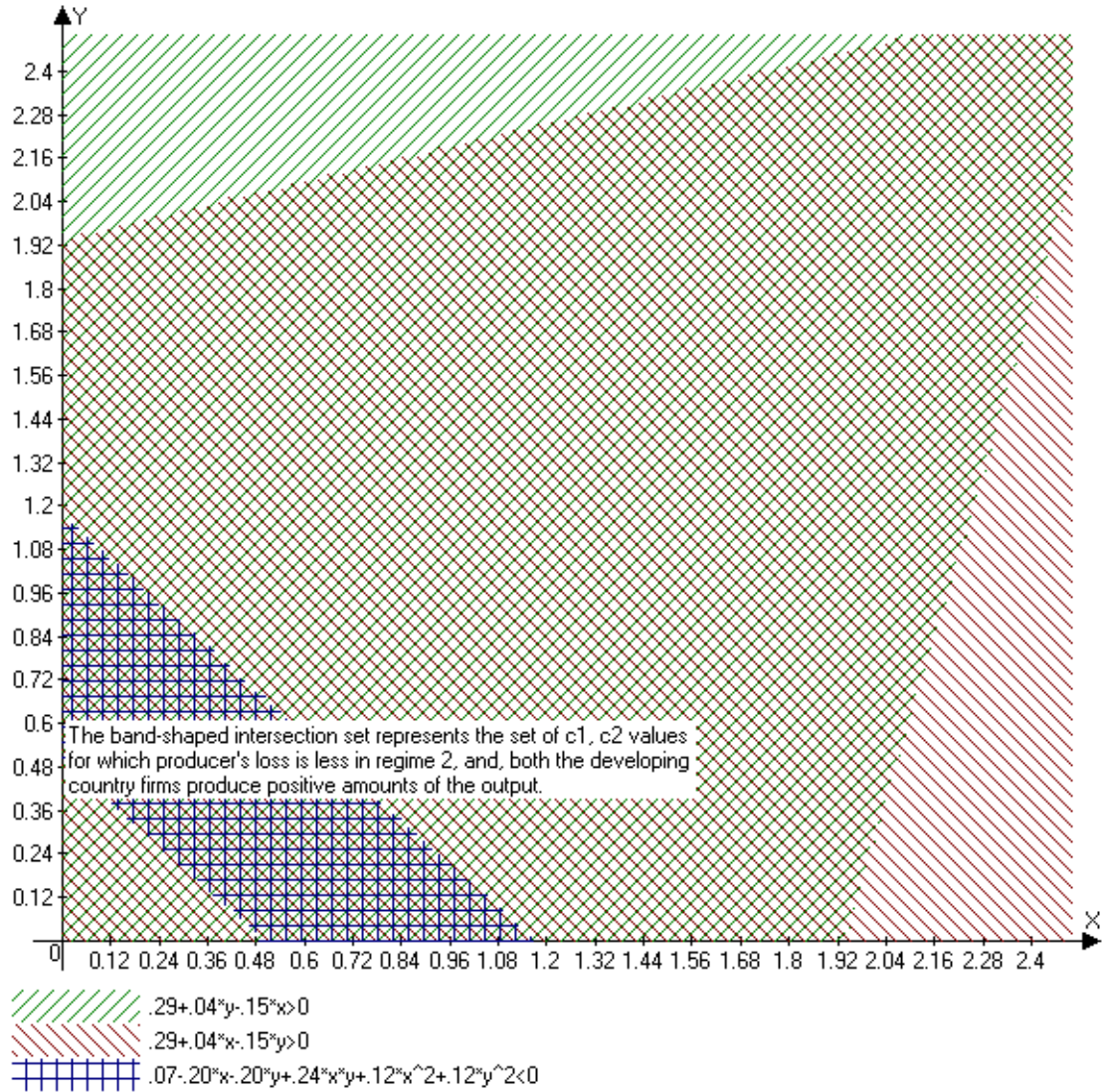
This is unambiguously positive, implying that OECD tariff revenues are higher in Scenario 2. The third and final component of OECD welfare is 'producer's loss (PL)', the change in which is given by:

$$\begin{aligned}\Delta PL &= (s(1)^* + s(2)^*)^2 - (s(1) + s(2))^2 \\ &= .07 - .20c(1) - .20c(2) + .24c(1)c(2) + .12c(1)^2 + .12c(2)^2\end{aligned}$$

It is evident from Figure 5 that cost levels are more likely to be such that OECD producers are worse off if developing countries act first during negotiations. This is

expected, since we have already seen that subsidy rates are likely to be higher in Scenario 2, leading to a higher quadratic loss function for OECD producers.

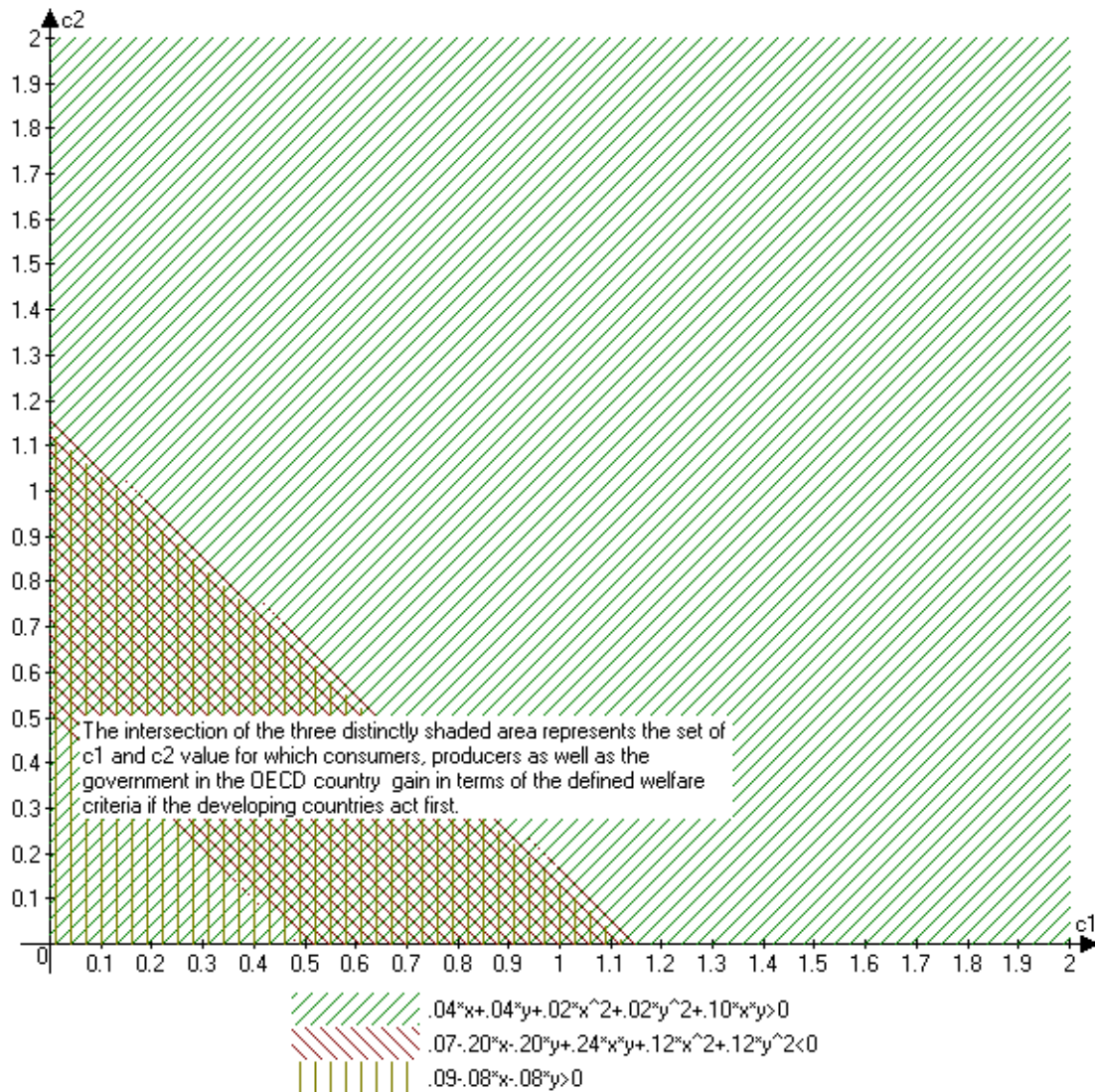
Figure 5
OECD producer's loss comparison



Source: Author.

If the negotiating countries will agree to a particular 'sequence' of proposed actions or not will depend critically on the comparative fates of the different stakeholders in their respective home countries. Figure 6 summarizes the political feasibility in the OECD of letting the developing countries act first.

Figure 6
Political feasibility of Scenario 2 in the OECD

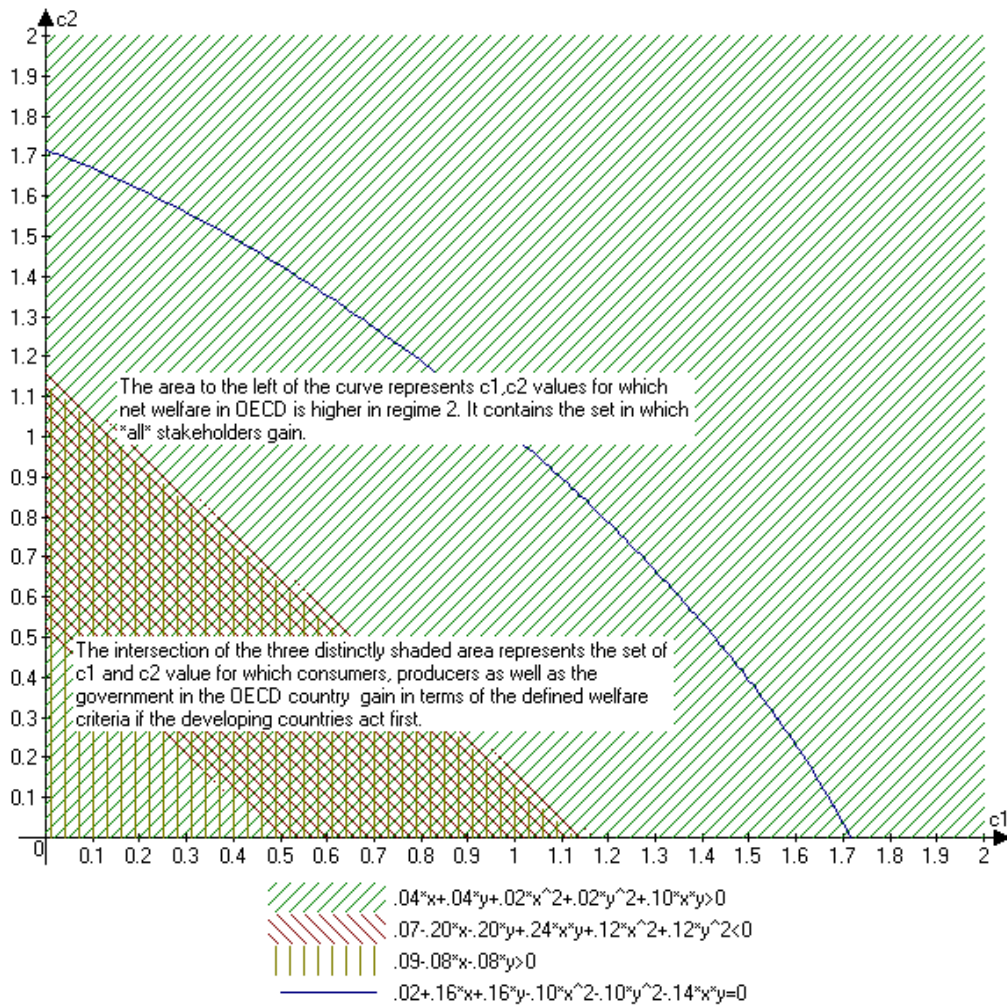


Source: Author.

Evidently, the small range of $c(1)$, $c(2)$ values for which all the stakeholders gain suggests that the OECD government is likely to face opposition within the country to agree to any proposal of letting the DCs act first in trade negotiations. What remains to be seen is whether there is scope for redistribution amongst stakeholders, to attain political feasibility. Net welfare change for the OECD is the sum of these three components (their changes) and is given by:

$$\Delta W = (CS+TR-PS)^* - (CS+TR-PS) = .02 + .16*c(1) + .16*c(2) - .10c(1)^2 - .10c(2)^2 - .14c(1)c(2)$$

Figure 7
Net change in OECD welfare and the scope for redistribution



Source: Author.

In Figure 7, if costs lie to the left of the curve, net welfare in the OECD country is higher if developing countries act first and choose optimal subsidies. As we have seen earlier, the chief source of positive welfare gain is from enhanced tariff revenues, which, supposedly, accrues to the government. If costs lie to the left of the curve, but outside the intersection-band which implies gains for *all* stakeholders, the government can potentially redistribute the tariff revenues to compensate the losers. If the costs lie to the right of the curve, there cannot be scope for redistribution which can make everyone better off in Scenario 2.

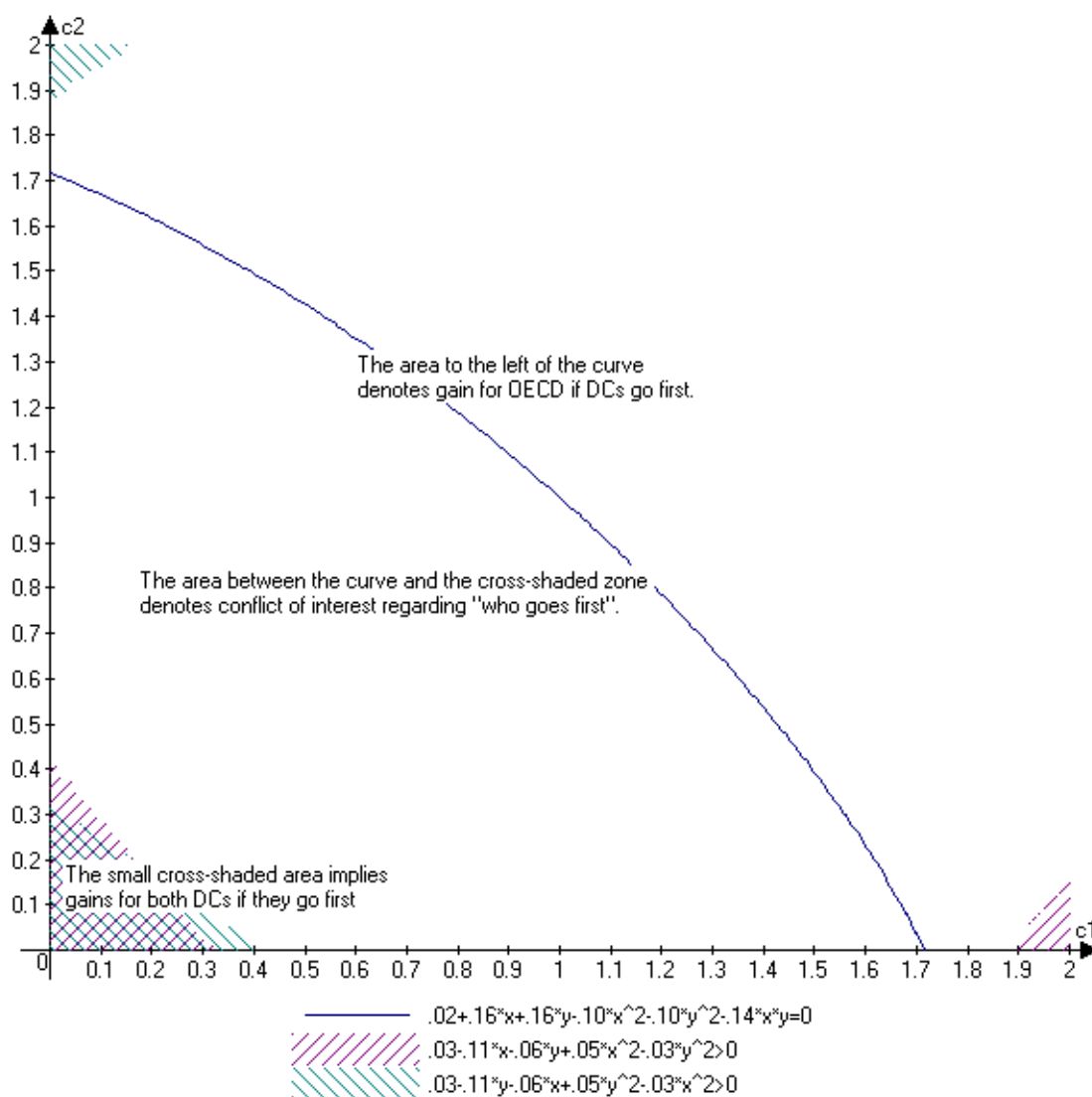
The area to the left of the curve is the 'low-cost' zone. One may argue that cost levels are lower in the more advanced developing countries with better technologies. Therefore, from the OECD's point of view, there is an economic rationale, supported by political feasibility, of having a relatively advanced developing country act first in bilateral negotiations. With technologically backward, hence high-cost, countries, the

OECD country will prefer to choose tariff levels first. We will discuss the possible implications of this for successful negotiations in the concluding section.

‘Welfare’ in the two developing countries (1 and 2) is synonymous with net exports in this model, which are, respectively, $.03-.11c(1)-.06c(2)+.05c(1)^2-.03c(2)^2$ and $.03-.11c(2)-.06c(1)+.05c(2)^2-.03*c(1)^2$. As Figure 8 demonstrates, DCs gain in Scenario 2 (that is, when they choose subsidy rates first) under quite extreme cost structures. To be precise, in Scenario 2,

- (a) both of the DCs gain if their costs levels are both very low, and
- (b) if the cost-asymmetry between the developing countries is extreme, the high-cost developing country gains and the other loses.

Figure 8
Conflict of interest



Source: Author.

Conclusion

The primary motivation behind the paper is to envisage a logical framework explaining why some trade negotiations are delayed because parties differ on who should ‘go first’. We find that under circumstances such as the one described in the model, there are substantive welfare implications depending on which party sets tariff rates (or subsidies) first in a strategic optimization exercise. When knowledge about cost levels are incomplete or missing, and hence must be guessed with a probability, the chances of conflict regarding who goes first are extremely high in the situation modeled in this paper.

These findings have the following policy implication for the WTO. As an institution with some power to set the rules of negotiations, the WTO should be able to anticipate such conflicts in upcoming negotiations. It can then set the rule (in this case, dictate who should go first) depending on whose interest it wants to protect. There is a wide range of choices for the WTO in this regard: OECD consumer’s surplus, OECD producers’ loss, net exports of developing countries, firm profits⁵ or even, world welfare as the sum of all these components.

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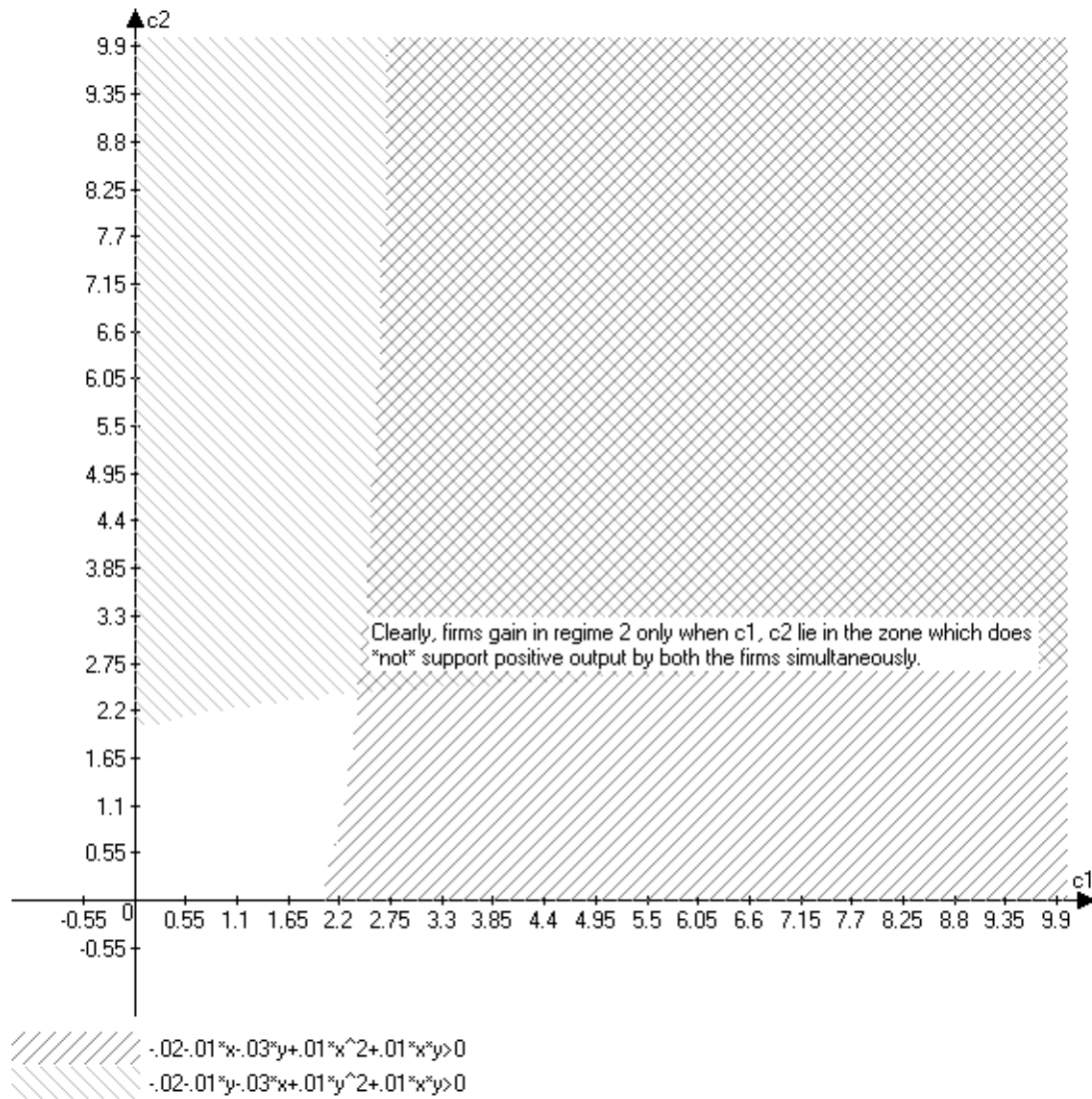
⁵ In this model, firms gain in Scenario 2 only if cost levels are such that they *do not* support positive outputs by both firms simultaneously. See Appendix.

Appendix

The net changes in Firms 1 and 2's profits (Scenario 2-Scenario 1) are, respectively,

$$-.02-.01c(1)-.03c(2)+.01c(1)^2+.01c(1)c(2) \text{ and}$$

$$-.02-.01c(2)-.03c(1)+.01c(2)^2+.01c(1)c(2)$$



Source: Author.