Does MFN Status Encourage Quality Convergence?

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Abstract

We investigate the welfare implications of the choice of tariff regime by an importing country on quality competition between a firm located in a developed exporting country and a firm in a less developed exporting country. The results show that the less developed country prefers the uniform tariff regime (or MFN status) promoted by trade agreements only when this causes convergence in quality relative to the outcome with discriminatory tariffs. Whether quality convergence occurs depends on the structure of the strategic trade policy game. In every case the interests of the developed exporter and the importer are always aligned, and counter to the interest of the less developed exporter. This latter result provides an insight into why the Doha Round has found agreement so difficult to achieve. The less developed exporting country prefers the uniform tariff only if the importer will commit to this regime, but the importer will not commit to this regime because it benefits from applying discriminatory tariffs.

Keywords: MFN clause; imperfect competition; strategic trade policy; quality competition

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Highlights

- We model the choice of the tariff regime by an importer when a developed exporter and a less developed exporter compete in quality.

- We show that the uniform tariff regime (or the Most Favoured Nation status) promoted by trade agreements is not always in the interest of the less developed exporter.

- The less developed exporter prefers the uniform tariff regime only when this causes quality convergence.

- For all considered structures of the strategic trade policy game the interests of the developed exporter and the importer are always aligned, and counter to the interest of the less developed exporter.

- Our results provides an insight into why the Doha Round has found agreement so difficult to achieve.
1 Introduction

A key step on the development path occurs when a less developed country moves from the production of low value-added basic commodities to the production of higher value-added manufactured goods. It is clear that some tariff policies will hinder the attainment of this transformation. Stiglitz and Charlton (2007) observe that developed countries on average levy higher tariffs on processed food products than they do on unprocessed, which discourages developing countries from investing in processing facilities. Even when some industrialization has been achieved the products of developing countries will usually be lower down the quality ladder than those of established manufacturers. This is illustrated by Japanese cars in the 1970s, South Korean cars in the 1990s, and the current situation with Chinese cars. The development process can only be complete when a product is produced that is on the quality frontier. The question this paper asks is whether the trade policies at the heart of the Doha Round of trade talks, in particular the policy of non-discriminatory tariffs, are necessarily the most encouraging for the enhancement of product quality by developing countries.

The award of Most Favoured Nation (MFN) status to a less developed country exposes it to levels of tariff that are no higher than charged to any other country. This absence of discrimination is, in effect, the outcome that is sought in many trading agreements. Having MFN status gives a less developed country trading parity with developed countries and should in the long-run be desirable. In the short-run the less developed country is starting with a technological deficiency relative to developed countries that inhibits its advancement of product quality. Given this asymmetry, it is not obvious that the symmetry of MFN status is the most beneficial outcome for the less developed country while it retains a quality deficit. In should also be observed that the least-developed countries currently benefit from lower tariffs and preferential market access under the Generalized System of Preferences (GSP) so that attainment of MFN status would cause an increase in tariffs. It might be expected that this increase will be detrimental for such countries, so acting as a deterrent to joining the trade agreement. The strength of this observation is moderated by the many critics of GSP, such as Grossman and Sykes (2005), who argue that GSP is frequently targeted at incorrect product groups and generally ineffective.

To address these issue, the paper considers how the choice of the tariff regime by an importing country affects the welfare of exporting countries. In particular, we consider whether the MFN regime is advantageous for the less developed exporter. The main message of this paper is that applying simple logic to increases or decreases in tariffs needs very careful assessment. Whether MFN status is advantageous for a less developed country depends upon the process of strategic interaction between exporters and importers in the formulation of trade policy. What is clear is that the developed exporters and developed importers have interests that are aligned, but always counter those of the less developed exporters. Hence, when a less developed countries gain from MFN status, the developed countries gain from denying it. The converse is true when
developing countries prefer not to have MFN status. This finding provides an new perspective on why the Doha Round of trade talks - the first to include a significant number of less developed countries - has failed to reach agreement.

Two important facts about strategic trade policies should be kept in mind when considering our results. First, it should be noted that goods produced by imperfectly competitive industries tend to be underprovided from the perspective of the importing country. Therefore, other things being equal, policies that subsidize such goods actually tend to reduce the inefficiency resulting from the imperfect competition. Second, strategic trade policies typically have a beggar-thy-neighbor aspect. Therefore, countries that compete with each other, by implementing strategic trade policies, have an incentive to make bilateral or multilateral agreements that reduce or prevent such policy rivalries. This is the self-enforcing argument in favour of international trade treaties such as the MFN clause regarding tariff regimes. In the WTO’s tariff guidelines it is noted that countries should comply with the MFN clause. Our analysis allows us to address the ongoing debate on whether the WTO rules have an economic rationale and what additional policies should be considered to rationalize such rules.

This paper builds on the work of Choi (1995) and Ishii (2013). Choi contrasts the technology choice of exporters under a discriminatory tariff regime to the choice under MFN status. In his model firms can reduce the marginal cost of production by paying an investment cost; that is, by investing in process R&D. He shows that a lower marginal cost technology will be chosen with MFN status but, typically, at a welfare cost for exporting countries. Ishii (2013) revises the Choi model by assuming that the investment is made in product R&D, that is, it raises product quality rather than reduces production cost. The focus of his paper is on the effect of subsidies to R&D (which are absent in the Choi model), and how this affects the degree of competition, so the tariff policy of the importing country is not considered. The central finding is that the governments of the exporting countries will choose to subsidize product R&D.

We consider a world with three countries, one of which is the importer of a product and the other two are exporters. One of the exporters has an advantage in the enhancement of product quality so that there is a fundamental asymmetry in the model. We interpret the advantaged exporter as a developed country in which is located a firm with experience in production and the disadvantaged exporter as a less developed country that hosts a firm with limited experience of production. The firms choose their level of investment in product R&D to raise product quality, and the host countries choose the extent to which they subsidize this investment. The importing country chooses the tariff to implement under either a discriminatory tariff regime or under an MFN system. The two exporting firms compete either in prices or quantities. We consider three alternative sequences of moves for the strategic trade policy game involving firms and countries. The first sequence has tariff policy chosen prior to the investment in R&D. This sequence requires pre-commitment by the importer and so is subject to the criticism that there may be no mechanism to make this credible. The second sequence follows Choi (1995) by having the investment in
R&D chosen before the tariff policy is known, and subsidies are known to the firms when they invest. No pre-commitment is necessary for this sequence. In the third sequence tariff and subsidy policies are set simultaneously, and both are known to the firms prior to their R&D decisions.

In the three-country framework, with an importer and two exporters, there is a large body of literature that studies the strategic interaction between firms and the countries hosting them, on the one hand, and the importing country on the other. Brander and Spencer (1985) proved that, when the importing country is inactive in terms of policy making while the exporters are active in choosing their optimal policies, the Nash equilibrium involves an export subsidy. The subsidy helps to reduce the inefficiency arising from the imperfect competition and it is in the interest of the importing country since the pursuit of active trade policies by both exporters will bring down prices for the consumers in the importing country. If the importing country chooses to be active in the international domain it will set its own optimal discriminatory tariffs to extract rent from foreign exporting firms, thereby increasing its welfare. The rent extraction motive has been studied by Hashimzade et al. (2011a). They considered a world in which each country set its optimal policy to maximize own welfare and proved that with symmetric costs the exporters choose to tax their exports and the importing country chooses to impose tariffs on imports. Therefore, when all governments are active, the strategic policy-making option exacerbates the inefficiency arising from the imperfect competition. In this situation all countries will lose. Hashimzade et al. (2011b) showed that, in order to reduce the inefficiency arising from both imperfect competition and from strategic-policy making, the countries need to move toward freer trade by adopting the MFN clause. Other researchers have proposed other steps to move toward freer trade, such as prohibiting direct export subsidies among exporter countries. Collie (2000a, 2000b) explored how a world-wide agreement to prohibit export subsidies could be justified based on the opportunity cost of public funds. He proved that when the opportunity cost of the government revenue that financed the export subsidy exceeds a critical level, prohibiting direct export subsidies results in a global welfare gain. The aforementioned policies have also been recommended by the WTO during the Doha Round to eliminate export subsidies and support a uniform tariff regime.

Although the WTO explicitly forbids export subsidies, this ban does not extend to R&D subsidies. The economic rationale behind this reasoning has been based on the classical market failure argument provided by Arrow (1962). He argued that firms will not invest enough in R&D because the benefits of innovation cannot be reaped fully due to incomplete appropriability and knowledge spillovers between firms. Therefore, a public subsidy should be designed to support R&D projects with large long-run expected social returns but with low immediate private returns in order to reduce the market failure resulting from under-investment in R&D. Therefore, it is worth studying the impact of an R&D subsidy by exporting countries as a substitute for direct export subsidies. As mentioned above, the literature on this issue differentiates between cost-reducing R&D (process R&D) and quality-enhancing R&D (product R&D).
Process R&D was first studied in a third-market framework by Spencer and Brander (1983) in a model with two firms producing a homogenous product. In their model only the exporting countries were active in the policy-making domain while the importer was passive. They proved that the optimal process R&D policy was to employ a subsidy. DeCourcy (2005) extended the Spencer and Brander model in two dimensions. First, she allowed for R&D subsidization with spillovers among firms. Second, she modeled R&D cooperation among firms. Then she compared R&D cooperation with R&D subsidization and showed that R&D cooperation can be superior to the use of R&D subsidization. Choi (1995) chose the other extreme and assumed that only the importing country was active in terms of policy-making. Choi compared the impact of the importing country adopting a uniform tariff regime (MFN status) to the impact of discriminatory tariffs on the process R&D choice of the exporting firms. He showed that the adoption of the MFN regime decreased the welfare of the exporting countries while it increased the welfare of the importing country. Liao (2007) extended Choi’s model by incorporating R&D spillovers among firms. He compared free trade with two tariffs regimes and shows that there are some situations in which both the importing country and the exporting countries are better off under free trade. R&D policy has been studied under horizontal product differentiation by Lin and Saggi (2002) and Qiu and Tao (1998) with spillovers and without spillovers among countries. R&D policies have also been studied under vertical quality differentiation by Moraga-Gonzalez and Viaene (2005).

Product R&D has been studied in a third-market framework by Park (2001), in a model with two firms producing vertically differentiated products. In his model the importer was passive in policy-making whereas the exporters were active. He proved that the optimal policy of the exporters depended on the mode of competition. Under Bertrand competition, the government in the developed exporting country, hosting the high-tech firm, has an incentive to tax the product R&D activity of its firm while the government in the developing country, hosting the low-tech firm, has an incentive to subsidize its domestic firm’s R&D activity. Under Cournot competition the opposite is true: the developed exporter pays an R&D subsidy while the developing exporter imposes a tax on the R&D activity of its firm. These results contrast with the observed policies worldwide, since governments tend to subsidize R&D activities. Ishii (2013) considered active exporting countries and a passive importing country for product R&D. This paper extends the work of Ishii to the case where all countries are active in setting their optimal policies and contrasts product R&D levels, as well as the welfare implications for the importing and exporting countries, under discriminatory tariffs with those under the uniform tariff.

Section 2 describes the model that is used and the alternative timing sequences for the strategic trade policy game. Section 3 looks at the model with pre-commitment to tariff policy. Section 4 looks at the cases of no pre-commitment and simultaneous policy choice. Section 5 provides a discussion and interpretation of the results. Section 6 concludes. Derivation of some analytical results is given in the Appendix, and the detailed calculations are available from...
the authors on request.

2 Description of Model

The world economy consists of three countries. Two of these countries are labelled “exporters” and the third is an “importer”. There is one firm resident in each exporting country. Each firm produces one version of a quality-differentiated good. For any given quality levels, the two goods produced by the firms are imperfect substitutes (or complements) in consumption. Quality can be increased by incurring additional cost. One firm can increase quality at a lower cost than the other, and we interpret this firm as being located in a developed country. The other firm is located in a less developed country. The firms compete using quality and either price or quantity as strategic variables. Each exporting country can subsidize the R&D cost of quality improvement for its firm. The importing country can impose either discriminatory or uniform tariffs. The choice of a uniform tariff is equivalent to granting MFN status to both the developed and less developed countries.

It is assumed that there is a representative consumer in the importing country who values the quality of the product. We use the utility function of Ishii (2013) which is a modification of the linear-quadratic utility function commonly used in the strategic trade literature:

\[
U(q_0, q_1, q_2; z_1, z_2) = a(q_1 + q_2) + k(z_1 q_1 + z_2 q_2) - \frac{1}{2} (q_1^2 + q_2^2) - \gamma q_1 q_2 + q_0, \tag{1}
\]

where \(q_i\) denotes the quantity of good \(i\) and \(z_i\) the quality of good \(i\). Higher quality increases the desirability of the good. The parameter \(\gamma \in [-1, 1]\) captures the degree of substitutability between goods 1 and 2 of the same quality, with \(\gamma = 1\) corresponding to perfect substitutability and \(\gamma < 0\) corresponding to complementarity between the goods. Good 0 is a freely-traded numeraire good, produced by a competitive industry using a linear technology with labour as the only input. Good 1 is produced by firm 1 which is located in country 1 (the developed country), and good 2 by firm 2 located in country 2 (the less developed country).

The utility function (1) gives rise to the linear demands for goods 1 and 2

\[
q_1 = \frac{a(1 - \gamma) + k(z_1 - \gamma z_2) - p_1 + \gamma p_2}{1 - \gamma^2}, \tag{2}
\]

\[
q_2 = \frac{a(1 - \gamma) + k(z_2 - \gamma z_1) - p_2 + \gamma p_1}{1 - \gamma^2}, \tag{3}
\]

where \(p_i\) denotes the price of good \(i\). The inverse demands are given by

\[
p_1 = a + k z_1 - q_1 - \gamma q_2, \tag{4}
\]

\[
p_2 = a + k z_2 - q_2 - \gamma q_1 \tag{5}
\]
The welfare of the importing country is determined by the sum of the utility of the representative consumer and the revenue from the imposition of tariffs. Under the *discriminatory tariff regime* the importing country imposes, in general, different tariffs, \( t_1 \neq t_2 \), on goods imported from the two exporting countries. Thus,

\[
W^D_I = U + t_1 q_1 + t_2 q_2.
\]

Under the *uniform tariff regime* (or MFN regime) the importing country imposes a uniform tariff rate, \( t = t_1 = t_2 \), on the imported goods. Hence,

\[
W^U_I = U + t [q_1 + q_2].
\]

We assume that under either regime the importing country chooses the tariff rates so as to maximize its welfare.

Firm \( i, i \in \{1, 2\} \), can choose the quality of its output by investing in R\&D activity. As in Ishii (2013), the quality level is an increasing concave function of the R\&D investment,

\[
z_i = z_i(I_i), \ z_i' > 0, \ z_i'' < 0, \ z_i(0) = z_{i0} \geq 0,
\]

and the R\&D investment in country \( i \) can be made at a constant price, \( P_i \). We assume that

\[
z_i(I_i) = z_{i0} + \theta_i I_i,
\]

so that the inverse is

\[
I_i(z_i) = \frac{[z_i - z_{i0}]^2}{\theta_i}.
\]

Given the convex cost of quality improvement, a large difference in the initial quality levels would require a considerable investment by the less developed producer in order to achieve quality convergence. Investment in quality is irreversible and is, therefore, a sunk cost. In order to focus on the issue of quality choice we assume that the marginal cost of production is not affected by the R\&D investment so we consider pure product R\&D. More generally, investment in R\&D could also lead to a decrease in production cost, as in Choi (1995), that is, a mix of the product R\&D and the process R\&D.

Each exporting country subsidizes the R\&D investment of its firm at a flat rate. There is no consumption of the quality-differentiated good in the exporting countries, so the welfare of exporting country \( i \) is the profit of its firm net of subsidies

\[
W_i = \Pi_i - s_i I_i.
\]

We assume that the exporting countries choose their subsidies simultaneously to maximize welfare.

Since the R\&D investment is a sunk cost, each firm chooses quantity (or price) to maximize its profit ignoring the R\&D cost. For simplicity, we assume that the production technology is characterized by a constant marginal cost. Thus, under Cournot competition the profit-maximizing quantities are

\[
q^C_i = \arg \max_{q_i \geq 0} \{ \pi_i = [p_i(q_i) - c_i - t_i] q_i \},
\]
and under Bertrand competition the profit-maximizing prices are

\[ p_i^B = \arg \max_{p_i \geq 0} \{ \pi_i = [p_i - c_i - t_i]q_i(p_i) \}. \]

For the purpose of comparing the equilibria under the two tariff regimes we are interested in an interior equilibrium, where both exporting countries produce strictly positive quantities and invest a strictly positive amount in product R&D. Using expressions (4)-(5) for the Cournot case (and (2)-(3) for the Bertrand case), the equilibrium quantities and prices for the Cournot case are

\[
q_i^C = \frac{a(2 - \gamma) + 2(kz_i - c_i - t_i) - \gamma(kz_{-i} - c_{-i} - t_{-i})}{(2 - \gamma)(2 + \gamma)}, \quad (6)
\]

\[
p_i^C = \frac{a(2 - \gamma) + 2(kz_i + c_i + t_i) - \gamma^2(c_i + t_i) - \gamma(z_i - c_i - t_i)}{(2 - \gamma)(2 + \gamma)}, \quad (7)
\]

and the equilibrium quantities and prices for the Bertrand case are

\[
q_i^B = \frac{a(2 - \gamma - \gamma^2) + (2 - \gamma^2)[kz_i - c_i - t_i] - \gamma(kz_{-i} - c_{-i} - t_{-i})}{(1 - \gamma)(1 + \gamma)(2 - \gamma)(2 + \gamma)}, \quad (8)
\]

\[
p_i^B = \frac{a(2 - \gamma - \gamma^2) + 2[kz_i + c_i + t_i] - \gamma^2kz_i - \gamma(kz_{-i} - c_{-i} - t_{-i})}{(2 - \gamma)(2 + \gamma)}. \quad (9)
\]

The choices of the governments and the firms are modelled as a four-stage game. Three alternative timing sequences are considered for this game. These timing sequences are distinguished by whether the importing country can pre-commit or not to the choice of tariffs. For each timing structure we determine the equilibrium for the uniform tariff regime (MFN) and the discriminatory tariff regime. We discuss the interpretation and merits of these alternative timing structures in section 5. The three timing structures are as follows:

**Case 1 Pre-commitment**

The first timing sequence models a situation in which the importing country can pre-commit to a particular tariff regime and does not deviate from the announced tariffs after observing the quality choices of the firms. The enforcement mechanism that sustains the pre-commitment could be an international agreement in place among the countries prior to the R&D investments being made.

The ordering of the four stages is:

*Stage 1.* The importing country chooses tariffs.

*Stage 2.* Exporting countries simultaneously choose subsidies to quality improvement.

*Stage 3.* Firms simultaneously choose the quality levels of their products.

*Stage 4.* Firms simultaneously choose price (Bertrand) or quantity (Cournot).

It is possible to combine Stages 3 and 4 into a single stage since this does not change the equilibrium outcome.

**Case 2 No pre-commitment**
In this timing sequence the importer cannot pre-commit to the choice of tariffs, so the exporters have to decide on the quality level of the product before tariffs are known. The interpretation of this sequence of moves is that investment in R&D is a long-term decision, whereas tariffs can be changed over a shorter time period. Thus, the importing country observes the quality of the goods and then chooses the tariffs that maximize its welfare.

The ordering of the four stages is:

- **Stage 1.** Exporting countries simultaneously choose subsidies to quality improvement.
- **Stage 2.** Firms simultaneously choose the quality levels of their products.
- **Stage 3.** The importing country chooses tariffs.
- **Stage 4.** Firms simultaneously choose price (Bertrand) or quantity (Cournot).

### Case 3 Simultaneous choice

The final timing sequence describes a situation in which the policy choices of the importing and the exporting countries are made simultaneously. Once chosen, the policies cannot be changed in the subsequent stages of the game.

The game under this assumption has three stages (but the equilibrium outcome does not change if Stages 2 and 3 are combined into a single stage):

- **Stage 1.** The importing country chooses tariffs and the exporting countries simultaneously choose their subsidies to quality improvement.
- **Stage 2.** Firms simultaneously choose the quality levels of their products.
- **Stage 3.** Firms simultaneously choose price (Bertrand) or quantity (Cournot).

For all three timing sequences the game is solved by backward induction, and the welfare levels for all three countries (and the world level of welfare) are calculated for the two tariff regimes. We then determine the preferences of the countries over tariff regimes, and relate preferences to quality convergence.

### 3 Pre-commitment

When there is pre-commitment the developing country can make a credible announcement of the tariff regime and the levels of tariffs. The announcement is accepted by the exporting countries and they choose their subsidies to R&D taking the tariffs as known. The firms then choose quality and compete either in prices or quantities with the outcome given by (6) and (7) or (8) and (9).

#### 3.1 Discriminatory tariff regime

At the third stage of the game the exporting firms choose output quality (or, equivalently, the level of product R&D investment) to maximize profit net of the R&D cost, taking the R&D subsidy and tariffs as given. Hence,

\[
z_{ij}^{Dj} \left( s_i, t_1^{Dj}, t_2^{Dj} \right) = \arg \max_{z_i \geq 0} \left\{ \Pi_i = \pi_i^{Dj} (z_i) - P_i I_i (z_i) + s_i I_i (z_i) \right\}, \quad j = B, C.
\]

(10)
At the second stage of the game each exporting country maximizes its welfare by choosing the R&D subsidy to its firm taking tariffs as given and taking account of the quality choice at the third stage. Using the choices from the third stage of the game, the optimal subsidy is defined by
\[ s_{Dj} = \arg \max_{s_i} \left\{ W_i = \pi_i^{Dj} \left( z_i^{Dj} \left( s_i, t_1^{Dj}, t_2^{Dj} \right) \right) - P_t I_i \left( z_i^{Dj} \left( s_i, t_1^{Dj}, t_2^{Dj} \right) \right) \right\}, \quad j = B, C \] (11)

The equilibrium subsidies are found by solving the system of first-order conditions for the two exporting countries. Under the discriminatory tariff regime the importing country chooses a separate tariff for the two exporters in the first stage of the game. The choice of tariffs takes into account the responses in the later stages of the game. The tariffs are defined by
\[ \left\{ t_1^{Dj}, t_2^{Dj} \right\} = \arg \max_{n} \left\{ W^D = U \left( q_1^j (t_1, t_2), q_2^j (t_1, t_2) ; z_1, z_2 \right) \right\}, \quad j = B, C. \]

3.2 Uniform tariff regime

Under the MFN regime the importing country applies a uniform tariff to imports from both the exporters. The solutions for the third stage of the game are defined by
\[ z_{Uj} (s_i, t^{Uj}) = \arg \max_{z_i \geq 0} \left\{ \Pi_i = \pi_i^{Uj} (z_i) - P_t I_i (z_i) + s_i I_i (z_i) \right\}, \quad j = B, C. \] (12)

In the second stage of the game each exporting country maximizes its welfare by choosing the R&D subsidy to its firm. The optimal subsidy is defined by
\[ s_{Uj} (t^{Uj}) = \arg \max_{s_i} \left\{ W_i = \pi_i^{Uj} \left( z_i^{Uj} \left( s_i, t^{Uj} \right) \right) - P_t I_i \left( z_i^{Uj} \left( s_i, t^{Uj} \right) \right) \right\}, \quad j = B, C. \] (13)

Finally, at the first stage, the importing country solves
\[ t^{Uj} = \arg \max_{t} \left\{ W^U = U \left( q_1^j (t, t) , q_2^j (t, t) ; z_1, z_2 \right) \right\}, \quad j = B, C. \] (14)

3.3 Comparison of regimes

We wish to compare the welfare implications of the two tariff regimes for the exporting countries and the importing country when one of the exporting countries is less developed than the other. Country 2 is the less developed country, so R&D investment in country 2 is more expensive (perhaps, because it is more difficult to implement R&D in a less developed country) and/or less efficient than in country 1. This means that either \( P_2 > P_1 \), or \( \theta_2 < \theta_1 \), or both.
3.3.1 Special case: independent demands

As an illustration of the general results we first present an explicit solution for the welfare difference under the assumptions that \( c_i = 0 \), \( z_{i0} = 0 \), and \( \gamma = 0 \). In principle, the developed country could also have an initial quality advantage \( (z_{10} > z_{20}) \) over country 2; this would not cause a qualitative change in the main result. In this case the outcomes for Cournot and Bertrand competition between the firms are identical and, as shown in the Appendix, the welfare function of exporter \( i \) has a unique maximum at \( s_i = 0 \), irrespective of the values of the remaining parameters and the tariffs.

The equilibrium tariffs under the discriminatory regime are given by

\[
t_i = \frac{a}{2} \left( \frac{2P_i - k^2 \theta_i}{3P_i - k^2 \theta_i} \right), \quad i = 1, 2,
\]

and the equilibrium quality level is

\[
z_i = \frac{a}{2} \left( \frac{k \theta_i}{3P_i - k^2 \theta_i} \right), \quad i = 1, 2.
\]

To ensure that the quality level is positive for both countries we assume that \( 3P_1 - k^2 \theta_1 > 0 \). The equilibrium tariff in the uniform case is given by

\[
t = \frac{a}{2} \left( \frac{A(k)}{B(k)} \right),
\]

where \( A(k) = \sum_{j=0}^{3} A_j k^{2j} \) and \( B(k) = \sum_{j=0}^{3} A_j k^{2j} \) are polynomials with coefficients given in the Appendix.

To simplify the welfare expressions we introduce the notation

\[
x_i = 3 - \frac{k^2 \theta_i}{P_i} > 0, \quad i = 1, 2.
\]

Recall that the exporter from country 2 is characterized by lower \( \theta \), or higher \( P \), or both. This implies that \( x_1 > x_2 \). Using this notation the welfare levels in the discriminatory regime are given by

\[
W_i^D = \frac{a^2}{4} \left( \frac{1 + x_i}{x_i^2} \right), \quad i = 1, 2
\]

and in the uniform tariff regime

\[
W_i^U = \frac{a^2}{4} \left( \frac{(1 + x_i)(1 + x_j)^2(1 + x_i + x_j)^2}{(x_i + x_i x_j + 4x_i x_j + x_i^2 x_j + x_j^2)} \right), \quad i, j = 1, 2, \quad i \neq j
\]

\[
W_3^U = \frac{a^2}{2} \left( \frac{(x_1 + x_2 + 2)^2}{x_1 + x_1 x_2^2 + 4x_1 x_2 + x_1^2 x_2 + x_2} \right).
\]
Taking the difference in welfare levels between the discriminatory regime and the uniform tariff regime gives

\[ W_D^1 - W_U^1 > 0, \]
\[ W_D^2 - W_U^2 < 0, \]
\[ W_D^3 - W_U^3 > 0. \]

These inequalities show that the importer and the developed exporter prefer the discriminatory regime. The less developed exporter prefers the uniform regime. The difference in the level of global welfare between the regimes is given by

\[ \sum_{i=1}^{3} (W_D^i - W_U^i) > 0. \]

Thus, global welfare is higher under the discriminatory regime.

This analysis illustrates the general finding for the case of pre-commitment: the discriminatory regime is preferred by two of the three countries. The case of uniform treatment, which is favoured by trade agreements, is preferred by the less developed country but is detrimental to the developed exporter and the importer. The results have been derived for a special case but the finding that the preferences of the two developed countries are aligned and opposite to the preferences of the less developed country holds true in more general circumstances. Formally, the simulations we now report show that the signs of the welfare differences are preserved in a much broader range of circumstances. This is a surprising finding since there is nothing in the model which necessarily aligns the interests of the developed countries. We discuss the interpretation of the result in greater detail below.

### 3.3.2 General case: substitutes and complements

The solution for the general case of \( \gamma \in [-1, 1] \) is algebraically cumbersome and does not allow for the analysis of the ordering of welfare levels under the two regimes. However, numerical results for a set of parameter values for which an interior equilibrium exists for the entire range of \( \gamma \) show that the pattern of welfare differences is the same as for \( \gamma = 0 \), both for Cournot and for Bertrand competition between the firms. The numerical results also reveal the relative values of tariffs for the two regimes and whether a move from discriminatory tariffs to a uniform tariff leads to quality convergence.

We illustrate the numerical solutions for the equilibrium for the following values of the model parameters: \( a = 1, c_1 = c_2 = 0, k = 5, P_1 = 10, P_2 = 15, \ z_{10} = z_{20} = 0, \ \theta_1 = 0.5, \ \theta_2 = 0.25. \) For this parameter configuration, and for a range of close values, the interior equilibrium exists over the entire range of \( \gamma \) in the Cournot case, and for a wide range of \( \gamma \) in the Bertrand case (excluding the range close to 1 and \( -1 \), corresponding to the strong substitutability and strong complementarity, respectively). Figures (1)-(5) illustrate the equilibrium for Cournot competition in the last stage of the game. The figures for Bertrand...
Figure 1: Tariffs ($t_{DC}^1$ solid, $t_{DC}^2$ dot, $t_{UC}^{}$ dash)

competition are qualitatively identical. In all the figures the value of $\gamma$ is plotted on the horizontal axis.

Figure 1 shows that with pre-commitment the discriminatory tariff is higher on exports from the less developed country than from the developed country. The uniform tariff is set at a level between the tariffs for the discriminatory case. This can be explained by observing that in equilibrium the firm from the developed country charges a higher price for its higher quality good. The importer benefits from levying tariffs that tend to equalize the post-tariff prices of the two goods so the that lower-quality import faces a higher tariff. In addition, the quality level of the good from the developed country falls faster as the tariff is increased than the quality level of the good from the less-developed country. Conversely, the price of the high quality good rises more quickly with the tariff than the price of the low quality. With pre-commitment the tariff is set taking all these factors into account, and they combine to give a lower discriminatory tariff on the higher quality good.

The equilibrium subsidies are shown in Figure 2; these are identical for the two tariff regimes. The subsidies are zero when the products have independent demands and are strictly positive when the goods are either substitutes or complements, with a greater subsidy imposed by the less developed country.

The effect of the tariffs and subsidies upon the equilibrium levels of quality are important for the potential convergence between the less developed country and the developed country. In the case of pre-commitment figure 3 shows that the quality level of the good from the developed country is lower with a uniform tariff than with discriminating tariffs, while the quality of the good from the less developed country is higher with a uniform tariff. A trade agreement that replaces discriminatory tariffs with a uniform tariff will cause convergence in quality which closes some of the gap between the developed and the less
developed countries.

Since the uniform tariff is set at an intermediate value between the two discriminatory tariff rates, imports from the firm in the less developed country faces a lower tariff under the MFN regime. Figure 4 confirms that this ensures that the less developed country is better off under with MFN status. The figure also shows that, in contrast, the developed exporter and the importer have higher welfare under the discriminatory regime. The ranking of regimes by the importer is aligned with that of the developed exporter.

The observation that both the developed exporter and the importer prefer the discriminatory tariff regime is reflected in global welfare. Figure 5 shows that the global welfare difference between the discriminatory and the uniform regimes is always positive. The benefit to the less developed exporter of the uniform tariff is not sufficient to give MFN a global advantage.

In summary, the welfare of the importer is higher under the discriminatory regime, and so a pre-commitment to the discriminatory regime is self-reinforcing. In contrast, the importer cannot make a credible pre-commitment to the MFN regime. Any such agreement must be enforced from outside the economic system. A trade agreement is one mechanism for achieving commitment, and we will discuss this argument in more detail below.

4 Alternative Timing Structures

In this section we analyze two alternative sequences of moves for the strategic trade game. The first of the two alternatives has subsidies chosen before quality levels, and then tariffs are chosen. This describes a situation where no pre-commitment is possible to the level of tariffs prior to the choices of the exporters and the firms. The second alternative considers simultaneous choice of all policy
Figure 3: Quality choices ($z_1^{DC}$ solid, $z_1^{UC}$ dot, $z_2^{DC}$ dash, $z_2^{UC}$ dashdot)

Figure 4: Welfare differences ($W_1^D - W_1^U$ solid, $W_2^D - W_2^U$ dash, $W_3^D - W_3^U$ dot)
Figure 5: Global welfare difference

instruments. We discuss the interpretation and applicability of these alternative timing structures in the next section.

4.1 No commitment

The equilibrium of the game with no pre-commitment is now analyzed using the solution from stage 4 given by (6) - (9). The analysis is undertaken separately for the discriminatory tariff regime and the uniform tariff regime. The figures display the results for Cournot competition; those for Bertrand are qualitatively identical.

At the first stage of the game the exporters choose their R&D subsidies. The optimal subsidies are shown in Figure 6. In the discriminatory tariff regime the export subsidies for the two countries are zero when the demands are independent ($\gamma = 0$), and are strictly positive for either substitutes or complements. In contrast, for the uniform tariff regime the subsidies are zero for $\gamma = -0.5$. Whether the subsidy for discriminatory tariffs or for a uniform tariff is higher depends on both the country and the value of $\gamma$.

Figure 7 shows the optimal choice of product quality by the firms under the two regimes. It can be seen that under the MFN regime both firms choose higher qualities, and that the quality choice by the firm located in the less developed country is lower than that of the firm in the developed country.

Next, the optimal tariffs are contrasted. Under the discriminatory regime the tariff faced by the exporter in the developed country is higher than that faced by the firm in the less developed country. Under the MFN regime the uniform tariff has an intermediate value (except when the goods are close substitutes); thus, the developed country faces a lower tariff, and the less developed country faces a higher tariff under the MFN regime relative to the discriminatory regime, as seen in Figure 8. One can argue, following Choi (1995) that a tariff for
Figure 6: Export subsidies ($s_{DC}^1$ solid, $s_{UC}^1$ dot, $s_{DC}^2$ dash, $s_{UC}^2$ dashdot)

Figure 7: Quality choices ($z_{DC}^1$ solid, $z_{UC}^1$ dot, $z_{DC}^2$ dash, $z_{UC}^2$ dashdot)
an exporter is equivalent to an extra production cost, and the discriminatory tariffs imposed by the importer serve to equalize the costs. Thus, the exporter that achieves any given quality level at a lower cost (the developed country) will be faced with higher tariff rate relative to the exporter for which raising quality is more costly (the less developed country). Under the uniform regime the common tariff will be located, in general, between the two discriminatory tariffs. It can be the case, as illustrated in Figure 8, that the common tariff rate is significantly higher for the less developed exporter than the discriminatory tariff, leading to lower profits, a higher subsidy, and, therefore, lower welfare.

Finally, we compare the welfare levels achieved under the two regimes. Figure 9 plots the welfare differences for the three countries. The figure shows that the welfare of the importing country and of the developed exporting country are higher with uniform taxation. However, the welfare of the less developed exporting country is lower under the MFN regime relative to the discriminatory tariff regime. Thus, the importer and the developed exporter would gain, and the less developed exporter would lose, if an international agreement were accepted that imposed uniform tariffs. Global welfare (not shown) is also lower with the uniform tariff.

These results are all reversed from pre-commitment. This is a consequence of the changed strategic roles of the policy instruments in this timing structure. When there is no commitment tariffs are chosen after subsidies and qualities are fixed. The level of tariff has no strategic impact upon quality, but can only influence the pricing decisions of the firms in the final stage of the game.

4.2 Simultaneous choice

With this order of moves tariffs and subsidies are chosen simultaneously at the first stage. This eliminates one aspect of the strategic trade policy game since
the choice of trade policy by the leading country cannot be used to manipulate the trade policy choices of the following countries. The firms then choose qualities, and final prices or quantities. The outcome is the same whether the two decisions of the firms are made simultaneously or consecutively. The equilibrium prices and quantities obtained at the last stage of the game are again given by (6)-(7) for Cournot competition and by (8)-(9) for Bertrand competition. Given the rates of tariffs and subsidies, the choices of R&D investment in quality by the firms are the same as with the first two alternative sequences of moves.

The optimal export subsidies have the same qualitative properties as for the first sequence of moves that characterized pre-commitment. The subsidies are the same for both tariff regimes, but the less developed country always choices a higher export subsidy. Both exporters levy a zero tariff when the goods are in independent demand ($\gamma = 0$). The behavior of the discriminatory and uniform tariffs are also the same as for the first sequence. The discriminatory tariff levied on imports from the less developed country is higher than the tariff on imports from the developed country. The uniform tariff falls everywhere between the two discriminating tariffs. Figure 10 shows the quality choices for the two regimes. The difference between quality levels is smaller in the uniform regime. Hence, a trade agreement that causes a move from discriminatory to uniform tariffs will assist quality convergence.

Figure 11 shows the welfare differences. The developed exporter and the importer prefer discriminatory tariffs. The less developed exporter prefers the uniform tariff. This figure once again shows that the preferences of the less developed exporter are diametrically opposed to those of the other two countries.
Figure 10: Quality choices ($z_{1}^{DC}$ solid, $z_{1}^{UC}$ dot, $z_{2}^{DC}$ dash, $z_{2}^{UC}$ dashdot)

Figure 11: Welfare differences ($W_{1}^{D} - W_{1}^{U}$ solid, $W_{2}^{D} - W_{2}^{U}$ dash, $W_{3}^{D} - W_{3}^{U}$ dot)
5 Discussion

The results we have presented reveal that the welfare consequences of discriminatory tariffs relative to a uniform tariff depend upon the order of moves in the strategic trade policy game played by the countries. In this section we summarize and compare the results, draw out their policy implications, and then discuss justifications for the alternative sequences of moves.

In the first sequence of moves the importing country commits to tariffs before quality choice is made. In this case, the developed exporter and the importer prefer the discriminatory tariff regime. Only the less developed exporter prefers the MFN regime. World welfare is also higher with the discriminatory regime. These results hold for both Cournot and Bertrand competition between firms. Here MFN is beneficial to the less developed country but not to the importer, and so there is no private rationale for the importer to implement the MFN regime.

In the equilibrium for the second sequence of moves world welfare is higher under the MFN regime. However, under the MFN regime only the importing country and the developed exporter are better off, whereas the less developed exporter is worse off, compared to the discriminatory regime. The importer will choose MFN and, since global welfare is also higher than under the discriminatory regime, the importer and the developed exporter could potentially transfer some of the surplus to the less developed exporter to compensate for the loss. The ranking of the two regimes by the countries is the precise opposite to that for the first sequence of moves.

Finally, in the third sequence of moves the importer and the two exporters simultaneously choose their policy variables before the producers make the choice of quality. The welfare implications are similar to those in the first sequence: the MFN regime benefits the less developed exporter, but makes the importer and the developed exporter worse off in comparison to the discriminatory tariff regime. The level of global welfare is also lower under the MFN regime. Note that in this sequence the importing country, effectively, pre-commits to the tariff regime and tariff levels before observing the quality choice of the exporters.

The key elements of these results are now presented in summary tables. Table 1 compares the levels of the strategic variables for the three alternative timing structures. Table 2 shows the effect on the relative product quality levels of the two exporters. Table 3 shows the preferred tariff regime of each country. Although the results depend on the ordering of moves it can be observed that the developed country and the importing country always have aligned interests. The less developed country always has the opposite preference. Furthermore, the less developed country always prefers the regime that leads to quality convergence where the other two countries prefer the regime that leads to quality divergence.

These findings have significant policy implications. The MFN regime is generally regarded as a better policy than discriminatory tariffs, although worse than free trade. The results of our analysis shows that MFN is only preferred by the less developed country in circumstances in which it is opposed by the developed exporter and by the importer. International agreements that impose
a uniform tariff need not, therefore, be in the interests of less developed countries. Moreover, the developed countries will only be willing to accept such international agreements when they are detrimental to the less developed country. From this perspective, it is hardly surprising that the Doha Round has faced considerable difficulties in reaching a widely accepted agreement.

These results raise the question of which is the most appropriate ordering of moves. A first observation in this regard is that the outcome with pre-commitment is aligned with observed trade policies. This sequence results in a lower tariff being levied on the import from the developed country relative to that from the less developed country, and quality convergence occurs under the uniform tariff. This is also the case in which the less developed country prefers the uniform tariff regime.

The previous literature has argued that the appropriate ordering of moves is dependent on what is viewed as the long-term decision. On this basis, the second sequence of moves can be justified using a similar argument to Choi (1995). He argues that the choice of technology is typically a long-term decision, whereas tariffs can be changed within a shorter time period. Furthermore, technology choice is irreversible, whereas the government of the importing country cannot pre-commit to the specific level of tariffs. Choi (1995) cites evidence from U.S. trade policy to support his argument. If this argument is accepted, it makes sense to place the choice of tariffs after the choice of technology. The first sequence of moves is justified if it is tariff policy that is the long-term decision. This could be rationalized by appealing to international agreements as being binding commitments that remove the freedom to set tariffs. The third sequence

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Discriminatory Tariffs</th>
<th>Subsidies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-commitment</td>
<td>Higher on less developed</td>
<td>Developed lower</td>
</tr>
<tr>
<td>No commitment</td>
<td>Lower on less developed</td>
<td>Developed lower</td>
</tr>
<tr>
<td>Simultaneous</td>
<td>Higher on less developed</td>
<td>Developed lower</td>
</tr>
</tbody>
</table>

Table 1: Values of strategic variables

<table>
<thead>
<tr>
<th>Sequence</th>
<th>Quality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-commitment</td>
<td>Convergence</td>
</tr>
<tr>
<td>No commitment</td>
<td>Divergence</td>
</tr>
<tr>
<td>Simultaneous</td>
<td>Convergence</td>
</tr>
</tbody>
</table>

Table 2: Effect on quality of moving from discriminatory to uniform tariffs
can be interpreted as a situation when neither country anticipates the policy choice of other two countries when making its own policy decision, or when countries cannot commit to an agreement ex ante but, once the policies are chosen, do not change them in the long run. In any case, it is of interest to observe that the three sequences produce outcomes that are at variance except for the fact that in every case the preferred tariff regime of the less developed country is the opposite to those of the developed exporter and the importer.

In addition, a long-term commitment to MFN may or may not be beneficial; in particular, it may not be beneficial for the developing exporter (in the context of our model), but even the importer's pre-commitment to discriminate (in order to benefit the less developed exporter) is not necessary if the trading countries agree on a redistributive transfer. Then the importer will have an incentive to implement the MFN mid-way (that is, the MFN regime becomes self-enforcing without pre-commitment), and the less developed exporter will receive compensation. This is an outcome that benefits all parties.

6 Conclusions

The sequence of international trade agreements since the first Geneva Round of 1947-48 have involved an ever-increasing number of countries. At the initiation of the Doha Round in 2001 there was a sense of expectation that it could deliver an agreement with benefits for the many less developed countries that were participating in the talks for the first time. These hopes were encapsulated in the informal sobriquet of the "development round". The reality was very different, and the talks failed to deliver a significant agreement.

We have attempted to capture some of the issues that lie behind the negotiations between developed and less developed countries over the terms of a trade agreement. The less developed country will be at a disadvantage with respect to the quality of the product that it produces so will look to for an agreement that assists with quality convergence. What our results have shown is that the less developed country prefers the uniform tariff treatment promoted by trade agreements only when this causes convergence in quality relative to the outcome with discriminatory tariffs. Perhaps more importantly, the interests of the developed exporter and the importer are always aligned and counter to the interest of the less developed exporter. This latter result provides another element in the explanation of why the Doha Round has found agreement so difficult to achieve. The less developed country prefers the uniform tariff only if the importer will commit to this regime, but the importer will not commit to this regime because it benefits from applying discriminatory tariffs.

The analysis has also raised questions about the modelling of strategic trade policy games. The preferences of tariff regimes are dependent upon the sequence of moves in the strategic game. It is not clear which is the correct sequence, and we have presented the competing arguments. At one level, this is not an issue that is easily resolved. At another, a trade agreement can play the role of a commitment devise that gives merit in the context of the policy issues we
have addressed to the analysis of the game with pre-commitment. There then remains the issue of finding a rationale for the importer to agree to commit to the agreement. If it benefits the less developed country then the importer will prefer not to be bound by an agreement.

Appendix

Here we present the analytical results for the special case of independent demands in the sequence of moves with pre-commitment.

When $c_i = 0$, $z_i = 0$, and $\gamma = 0$, the optimal quantities, prices and quality levels are

$$ q_i = \frac{a + kz_i - t_i}{2}, \quad p_i = \frac{a + kz_i + t_i}{2}, \quad z_i = \frac{k\theta_i (a - t_i)}{4(P_i - s_i) - k^2\theta_i}, \quad i = 1, 2. $$

These imply the welfare level of exporter $i$ is

$$ W_i = \frac{(a - t_i)^2 [4(P_i - s_i)^2 - P_i^2k^2\theta_i]}{[4(P_i - s_i) - k^2\theta_i]^2}, \quad i = 1, 2. $$

This function has a unique maximum at $s_i = 0$, so the quality levels given the optimal subsidy are

$$ z_i = \frac{k\theta_i (a - t_i)}{4P_i - k^2\theta_i}, \quad i = 1, 2, $$

and the resulting quantities and prices are

$$ q_i = \frac{2P_i (a - t_i)}{4P_i - k^2\theta_i}, \quad p_i = \frac{2P_i (a + t_i) - k^2\theta_i t_i}{4P_i - k^2\theta_i}, \quad i = 1, 2. $$

The equilibrium tariffs under the discriminatory regime are given by

$$ t_i = \frac{a}{2} \left( \frac{2P_i - k^2\theta_i}{3P_i - k^2\theta_i} \right), \quad i = 1, 2, $$

which gives for the equilibrium quality levels

$$ z_i = \frac{a}{2} \left( \frac{k\theta_i}{3P_i - k^2\theta_i} \right), \quad i = 1, 2. $$

The quality levels are positive when $3P_1 - k^2\theta_1 > 0$, and, therefore, we assume that

$$ \frac{k^2\theta_1}{P_1} < 3. $$

The equilibrium uniform tariff is given by

$$ t = \frac{a}{2} \left( \frac{A(k)}{B(k)} \right), $$

25
where \( A(k) = \sum_{j=0}^{3} A_j k^{2j} \) and \( B(k) = \sum_{j=0}^{3} A_j k^{2j} \) are polynomials with the following coefficients

\[
A_0 = - \left[ \frac{8 P_1 P_2}{\theta_1 \theta_2} \right]^2, \quad A_1 = \frac{32 P_1 P_2}{\theta_1 \theta_2} \left[ \frac{P_1}{\theta_1} + \frac{P_2}{\theta_2} \right],
A_2 = - \left[ \frac{P_1}{\theta_1} \right]^2 + 8 \frac{P_1 P_2}{\theta_1 \theta_2} + \left[ \frac{P_2}{\theta_2} \right]^2, \quad A_3 = \frac{P_1}{\theta_1} + \frac{P_2}{\theta_2},
\]

and

\[
B_0 = \frac{3}{2} A_0, \quad B_1 = \frac{5}{4} A_1, \quad B_3 = A_3, \quad B_2 = - \left[ 3 \left[ \frac{P_1}{\theta_1} \right]^2 + \frac{P_1 P_2}{\theta_1 \theta_2} + 3 \left[ \frac{P_2}{\theta_2} \right]^2 \right].
\]

To simplify the expressions we introduce the notation

\[
x_i = 3 - \frac{k^2 \theta_i}{P_i}.
\]

Using this notation the welfare levels in the discriminatory regime are given by

\[
W^{D}_i = \frac{a^2}{4} \left( 1 + x_i \right), \quad i = 1, 2
\]

\[
W^{D}_3 = \frac{a^2}{2} \left( \frac{x_1 + x_2}{x_1 x_2} \right)
\]

and in the uniform regime

\[
W^{U}_i = \frac{a^2}{4} \left( 1 + x_i \right) \left( 1 + x_j \right)^2 \left( 1 + x_i + x_j \right)^2, \quad i, j = 1, 2, \quad i \neq j
\]

\[
W^{U}_3 = \frac{a^2}{2} \left( \frac{x_1 + x_2 + 2}{x_1 x_2 + x_1 x_2 + x_1 x_2} \right)
\]

The welfare difference between the two regimes is given by

\[
W^{D}_i - W^{U}_i = \frac{a^2}{4} \left( x_j - x_i \right) \left( 1 + x_i \right)^2 \left( 3x_i + 2x_i x_j + x_j + 2x_i x_j + x_j \right) x_i \left( x_i + x_j^2 + 4x_i x_j + x_j^2 + x_j \right)^2
\]

\[
i, j = 1, 2, \quad i \neq j
\]

\[
W^{D}_3 - W^{U}_3 = \frac{a^2}{2} \left( x_1 - x_2 \right)^2 x_1 x_2 \left( x_1 + x_1 x_2 + 4x_1 x_2 + x_1 x_2 \right)
\]

Clearly, \( W^{D}_3 - W^{U}_3 \geq 0 \) and \( W^{D}_1 - W^{U}_1 \geq 0 \): the importer and the developed exporter prefer discriminatory regime. The less developed exporter prefers the uniform regime.
The difference in the global welfare is given by

$$\sum_{i=1}^{3} (W_i^D - W_i^U) = \frac{a^4}{4} \frac{f(x_1, x_2)}{(x_1 + x_1 x_2^2 + 4x_1 x_2 + x_1^2 x_2 + x_2)^2}, \text{ where}$$

$$f(x_1, x_2) = 5x_2^2 x_1 (x_1 + x_2) + (1 + 2x_1 x_2) (x_1^2 + x_2^3) + 11x_1 x_2 (x_1 + 2x_1 x_2 + x_2).$$

Thus, the global welfare is higher under the discriminatory regime.

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